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HOW-I-DO-IT

An extraperitoneal approach for complex flank, iliac, and lumbar hernia

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Abstract

Purpose The aim of this paper is to propose our four-step technique, an open extraperitoneal approach for complex flank, lumbar, and iliac hernias.

Methods A big polypropylene mesh is placed, covering and reinforcing all the lateral abdominal wall in an extraperitoneal space. Its borders are retroxiphoid fatty triangle and the costal arch cranially and the retropubic space caudally, psoas muscle, and paravertebral region posteriorly and contralateral rectus muscle medially. Mesh dimensions do not depend from the defect size, but prosthesis has to cover all the lateral abdominal wall.

Results No major complications have been reported. The mean length of stay is 4.8 days (range 3–11). Mean follow-up is 44.8 months (range 5–92). One recurrence (4.5%) has been reported at the 1-year clinical evaluation.

Conclusion In conclusion, we believe that regardless size and location of the defect, every complex lateral hernia requires the same extensive repair because of the critical anatomy of the region with a big medium-heavyweight polypropylene mesh placed in an extraperitoneal plane, the only one that allows adequate covering of the visceral sac.
Our technique is a safe, feasible, and reproducible treatment for this challenging surgical problem.

Keywords Flank hernia · Iliac hernia · Lumbar hernia · Lateral hernia · Transversal incisional hernia · Lateral bulge

Introduction

Lateral hernia is a relatively rare pathology with about 350 cases reported in the literature [1].Repair of this defect is still a debated topic in abdominal wall surgery.

In the European Hernia Society (EHS) classification of incisional abdominal wall hernia [2], four bilateral zones are described: subcostal (L1), flank (L2), iliac (L3), and lumbar (L4).

Even though the EHS classification provides a clear nomenclature and description of the borders of the four areas, some reports [3, 4] use the term "flank hernia" interchangeably with the terms referring to other lateral abdominal wall hernia locations, thereby causing confusion in the data and results.

Sometimes, the above anatomical compartments are difficult to differentiate, or hernias protrude along their borders, involving more than one area. Nevertheless, the specific location in the lateral abdominal wall has been found to have little impact on the choice of approach, and on clinical outcomes [5]. In other words, we believe that flank, iliac, and lumbar hernias can be treated by the same approach.

About 80% of lateral hernias are acquired. Congenital defects account for the other 20% and are usually discovered during infancy associated with other birth malformations [6].

The most common acquired lateral hernias are incisional hernias with a true hernia fascia defect after kidney, vascular, or hepatic surgery, with a reported incidence of 17.1% after surgical lateral incision [1]. Furthermore, an incision through the lateral abdominal wall can lead to a denervation

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and subsequent flank laxity and weakness, sometimes without a clear fascial defect but with evident flank bulging and symptoms [7].

Lateral hernia can also be a consequence of a traumatic injury or any situation in which there is a sudden increase in intra-abdominal pressure, for example a high-speed car crash with seat belt restraint [5].

Because of these different clinical situations, we use the term "lateral hernia" to refer to any post-operative bulge of the lateral abdominal wall, whether the patient presents an evident defect in musculoaponeurotic layers, which may or may not be associated with a hernia sac, or simply laxity and weakness of the musculoaponeurotic layers.

Lateral hernia repair remains a challenging procedure for general surgeons. The proximity of the defect to bony prominences and major neurovascular structures can make these repairs technically difficult. Moreover, the lack of good-quality data, including large series and long-term outcomes, has not made it possible to identify the best surgical approach.

The aim of this paper is to propose our four-step technique, an open extraperitoneal (see box 1) approach for complex lateral hernia.

The extraperitoneal space

The nomenclature "extraperitoneal space" refers to the space between the peritoneum and the investing fascia of the muscles. This space circumferentially surrounds the abdominal cavity and it can be divided into preperitoneal space (anteriorly), retroperitoneal space (posteriorly and laterally), and supraperitoneal pelvic space (caudally). The retroperitoneal tissue is confined between the parietal peritoneum of the posterior abdominal wall and the investing fascia of the diaphragm, psoas muscle, quadratus lumborum, and (laterally) transversus muscle. This investing fascia is in toto named the transversalis fascia [32].

Perhaps, the classic definition of the preperitoneal space is correct, but if one accepts the bilaminar formation of the transversalis fascia into the anterior and posterior laminae, two spaces are formed: (1) one between the peritoneum and the posterior lamina of the transversalis fascia, and (2) one between the two laminae of the transversalis fascia (Fig. 1). In some cases, the posterior lamina is not well developed and the space is limited by the peritoneum internally and the anterior lamina of the transversalis fascia externally (previously referred to as the transversalis fascia). Both laminae of the transversalis fascia insert inferiorly on the ligament of Cooper. Superiorly, they are, perhaps, united somewhere at the level of the anterior abdominal wall and then continue upward as the transversalis fascia [33].

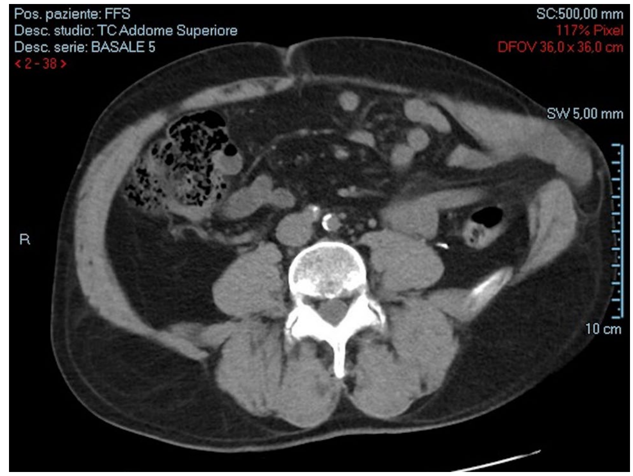

Fig. 1 Preoperative CT imaging

The iliac fossa is occupied by the iliacus muscle laterally, which converges with the tendon of the psoas muscle medially [34]. The retroperitoneal space extends between the iliacus fascia and the peritoneum. It continues medially to the retroperitoneal space (lumbar area), then downward to the pelvic wall, as well as forward to the anterior abdominal wall. We remind the reader that the iliac fascia is the inner investing fascia covering the iliacus muscle, equivalent to the transversalis fascia. These investing fasciae attach to the periosteum of bones (i.e., the iliac fascia attaches to the iliac crest, together with the transversalis fascia.) [32]

Methods

Patients

Using the Milan Hernia Center database, a retrospective review was performed to identify patients who underwent open repair of a complex lateral abdominal wall hernia between January 2012 and June 2019.

Cases with primary lateral hernia (Spigelian and lumbar Petit and Grynfellt) were excluded. Patient demographics, details of the surgical technique, and patient outcomes were recorded.

Primary outcome measures were surgical site occurrences (SSOs), surgical site infections (SSIs), and hernia recurrence. An SSO was any event that resulted in delayed healing of the incision [8], including cellulitis, seroma, hematoma, skin dehiscence, and necrosis. An SSI was defined according to criteria established by the Centers for Disease Control, and was classified as superficial, deep, or organ/space [9].

After hospital discharge, the patients were routinely reviewed at 1 and 6 months, and then every year thereafter.

The follow-up consultations consisted of a thorough clinical examination and an abdominopelvic computed tomography (CT) scan in cases of suspected hernia recurrence.

Preoperative evaluation

Preoperative evaluation included blood tests, chest X-ray, ECG, and surgical and anesthesiological evaluation.

A CT scan (Figs. 1 and 2) of the abdomen was obtained in all patients to: identify the size of the defect, if present, and its location in relation to the ribs, iliac crests and vascular structures; evaluate all the muscle layers involved (rectus abdominis, external oblique, internal oblique, and transversus abdominis muscle); and look for other possible abdominal wall defects.

Each patient routinely received a comprehensive explanation of his/her clinical situation and of the aim of the treatment and the possible post-operative complications and results. Patients mainly concerned with the bulge were informed that the esthetic result is not the main objective of this type of surgery and that the post-surgical flank shape could still be different from the shape of the contralateral side. Once they understood all these aspects, the patients signed an informed consent document. Quality of life was evaluated before surgery and at follow-up appointments.

Fig.2 Preoperative CT imaging

Surgical technique

This procedure is performed under general anesthesia. The patient receives standard prophylaxis against venous thromboembolism and preoperative antibiotics.

The patient is placed in a modified 20–45° lateral decubitus position (Fig. 3), rotated in the direction opposite to the abdominal wall defect, ensuring that the midline remains exposed. Nasogastric tube and urinary catheter are placed.

Incision and exposure

If a previous skin incision through the lateral abdominal wall is present, this is used for access; otherwise, a pararectal skin incision is the choice. The procedure starts with isolation of the hernia sac, if present, in the subcutaneous space. After identification of the border between the lateral edge of the rectus muscle and the external oblique aponeurosis, a longitudinal incision is made through the linea semilunaris to reach a plane behind the transversus muscle laterally and behind the rectus muscle medially (Fig. 4). If an old scar is used for access, if possible, we again prefer to identify the linea semilunaris and enter the extraperitoneal space in the way just described. Otherwise, the extraperitoneal space is reached through the hernia defect beneath the scar.

If possible, the identification of the extraperitoneal plane is performed without opening the abdominal cavity (see box 1). If it is necessary to open the hernia sac to verify the integrity of the viscera, a careful adhesiolysis is performed to avoid bowel damage.

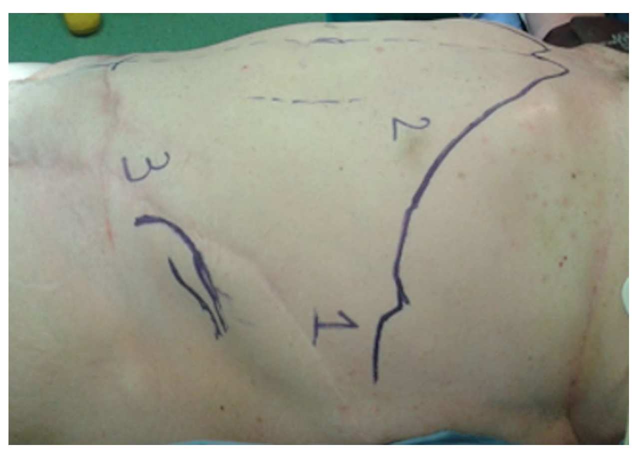

Fig.3 1, Patient in lateral decubitus position, costal arch, anterior superior iliac spine, and pubic bone are marked. 2, second step (cranial dissection); 3, third step (caudal dissection); 4, fourth step (medial dissection)

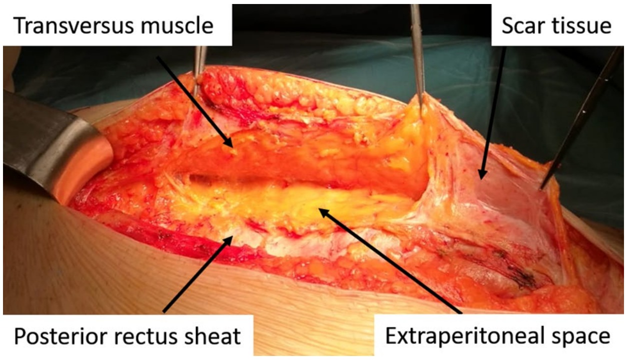

Fig.4 Semilunaris line is incised, identification of the extraperitoneal space

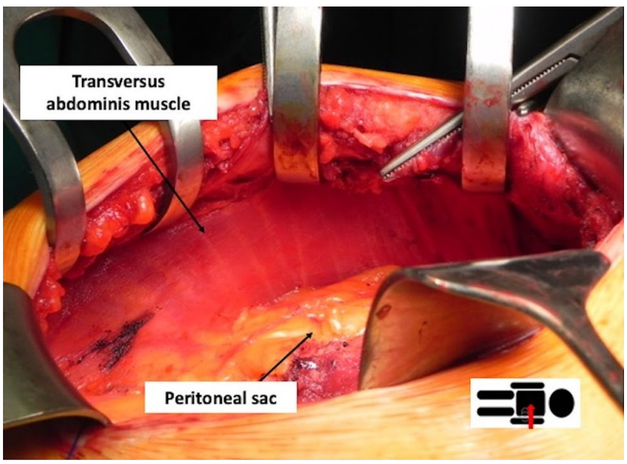

Fig.5 Posterior dissection in right lateral hernia: external, internal, and transversus muscles are retracted by the assistant

From this point, the procedure is divided into four steps to create an adequate pocket for a large mesh.

First step (posterior dissection)

The dissection begins in the extraperitoneal plane as previously specified. The external and internal oblique and transversus muscles are retracted by the assistant (Fig. 5) to follow a bloodless plane between the transversalis fascia and peritoneum, as far as the psoas muscle and quadratus lumborum and the paravertebral region.

Second step (cranial dissection)

The dissection proceeds in the extraperitoneal plane, moving cranially, at least 5 cm underneath the costal arch and the tenth rib (Fig. 6), care being taken not to cut the vertical diaphragmatic muscle fibers where they cross horizontally oriented transversus muscle fibers. The dissection proceeds to the xiphoid and then the retroxiphoid fatty triangle for at least 3 cm (Fig. 7). An absorbable stitch is placed on the xiphoid. It will be used later for the fixation of the mesh.

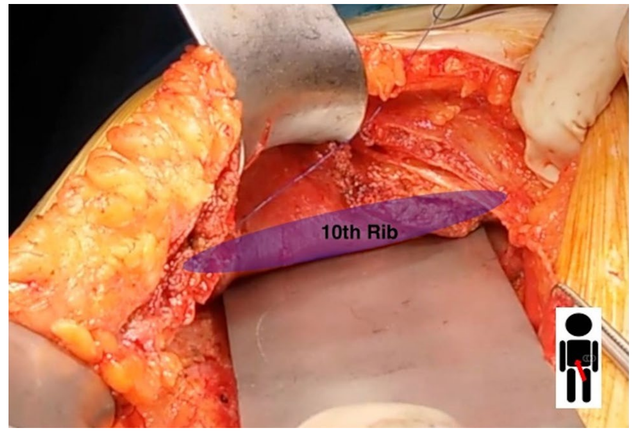

Fig.6 Right lateral hernia, dissection proceeds until 5 cm beneath the costal arch

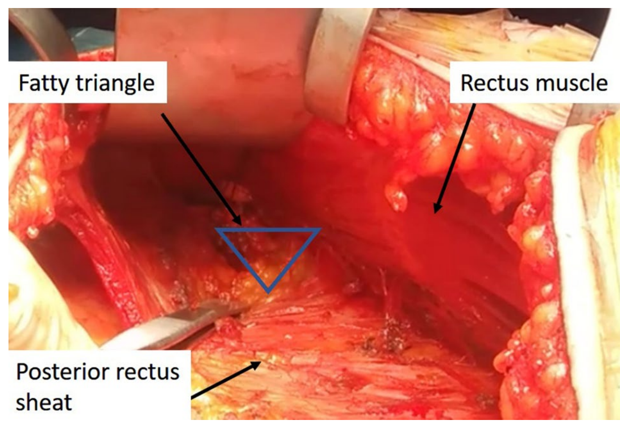

Fig.7 Right lateral hernia, cranial dissection is completed with preparation of the fatty triangle

Third step (caudal dissection)

Blunt dissection proceeds caudally and the entire iliac wing is exposed in the extraperitoneal plane (Fig. 8). Then, proceeding medially, the iliac vessels and Bogros space are isolated, as far as the Retzius space and homolateral Cooper ligament, pubic symphysis, and contralateral Cooper ligament (supraperitoneal space). At this stage of the procedure, in male patients, cord structures are isolated, saved, and parietalized. An absorbable stitch is placed on the pubic symphysis during this step. It will also be used later for the fixation of the mesh.

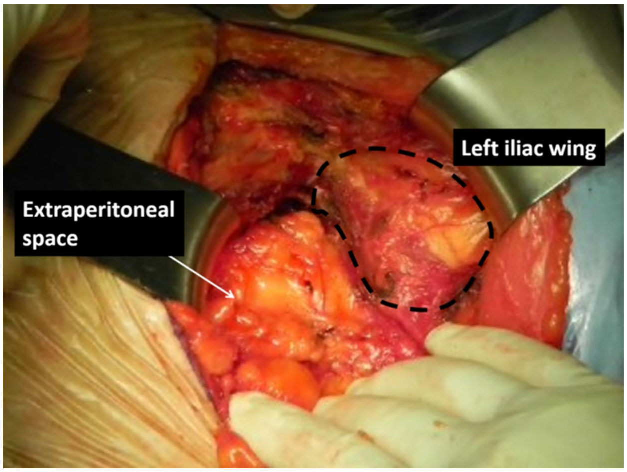

Fig. 8 Iliac wing is prepared

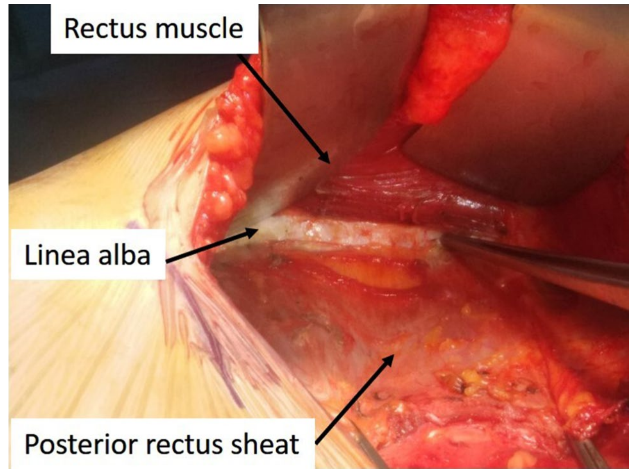

Fig. 10 Identification of the linea alba during medial dissection

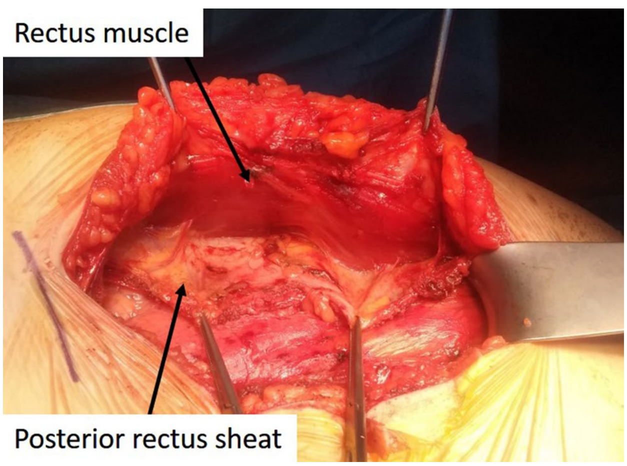

Fig. 9 Medial dissection in the retromuscular space

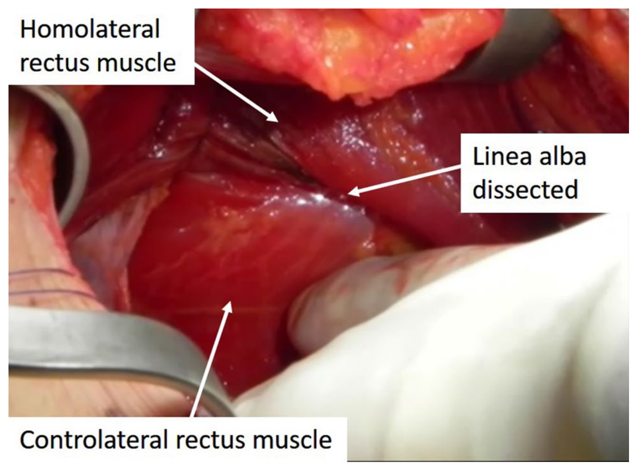

Fig. 11 Medial dissection in the contralateral retrorectus space

Fourth step (medial dissection)

The dissection proceeds medially in a retromuscular–preperitoneal plane (Fig. 9) (respectively, above and below the arcuate line), advancing at least 2 cm beyond the linea alba (Fig. 10), in the contralateral retrorectus–preperitoneal space (Fig. 11).

Mesh placement

By the end of the dissection, a large pocket, able to take a large mesh, has been created in an extraperitoneal space: its borders are the retroxiphoid fatty triangle and the costal arch cranially and the retropubic space caudally, the psoas muscle and paravertebral region posteriorly, and the contralateral rectus muscle medially.

Closure of the peritoneum, if needed, is obtained with an absorbable running suture.

A large polypropylene mesh is placed in the pocket prepared, covering and reinforcing the entire lateral abdominal wall. The two stitches previously placed (one on the xiphoid process and the other on the pubic symphysis) are used to guide the edge of the mesh to the correct position and hold it in place it during the closure.

The mesh is spread "like a sheet on a mattress", from the contralateral rectus muscle to the psoas, muscle and from 5 cm beneath the costal arch to the iliac wing and retropubic space (movie 1).

The mesh size does not depend on the defect size, but the prosthesis has to cover the entire lateral abdominal wall.

Fibrin is sprayed on the entire surface of the mesh.

A drain is placed in the mesh plane, before proceeding with the closure step. This involves approximating the lateral muscles to the semilunaris line. If possible, the edges of the musculo-fascial defect are reapproximated. This is usually easily performed without tension. If a large sac has been reduced, a further drain is placed in the subcutaneous space.

At the end of the procedure, a compressive elastic band is place and kept almost for 1 month.

Table 2 Operative details

OR details	Mean (range)
Defect size	232 cm^2 (30–756)
Mesh size	1025,5 cm^2 (750–2340)
Mesh details	Number (%)
Medium-weight polypropylene (> 70 g/m and < 140 g/m)	3 (13.6)
Heavy-weight polypropylene (> 140 g/m)	19 (86.4)

Results

From January 2012 to June 2019, 22 patients, 15 males and 7 females, underwent open extraperitoneal mesh repair for symptomatic lateral hernias. Their mean body mass index (BMI) at the time of the operation was 27.5 kg/m^2 (range 21.1–36.6) and they had a mean age of 61.7 years (range 30–80). Tables 1 and 2 summarize the patients' demographics, comorbidities, and hernia details.

Almost all the patients, 21 out of 22, presented post-surgical hernias; the one exception had a traumatic etiology, secondary to a frontal car crash. Ten patients (45.5%) had previously undergone between one and three previous flank hernia repair attempts. Incarceration occurred in three cases (13.6%). In 16 patients (72.7%), a true defect of the lateral abdominal wall was present at clinical evaluation and preoperative CT scan; this was associated with a bulge of the lateral abdominal wall in 13 patients (group A), while the other three patients (group B) presented only a musculoaponeurotic defect without bulging. In six patients (27.3%) (group C), only a bulge due to denervation was present.

The mean hernia defect size was 232 cm^2 (range 30–756). In all 22 cases, a synthetic mesh was used with a mean mesh size of 1025.5 cm^2 (range 750–2340): in 19 cases, this was a heavyweight polypropylene mesh (> 140 g/m) [10], while in the other three cases, it was a medium-weight polypropylene mesh (> 70 g/m and < 140 g/m) [10]. Medium-weight mesh was used in patients with a low BMI and small hernia defect with no bulging.

No intraoperative complications were reported. Two patients at high risk of complications due to comorbidities (both obese with a BMI of 36.6 and 30.7, respectively, and both cardiopathic on anticoagulant therapy) required blood transfusions for post-operative anemia. They subsequently developed subcutaneous hematoma, later evolving into seroma. One of these patients developed skin dehiscence;

Table 1 Patients' characteristics

Demographics	Mean (range)
Age	61.7 (30–80)
BMI (Kg/m^2)	27.5 (21.1–36.6)
Male/female	15/7
Comorbidities	Number (%)
Ischemic heart disease	3 (13.6)
COPD	2 (9)
Diabetes	4 (18.2)
Tobacco use	4 (18.2)
Hernia details	Number (%)
Postsurgical etiology	21 (95.4)
Traumatic etiology	1 (4.6)
Recurrent o multirecurrent	10 (45.5)
Incarcerated hernia	3 (13.6)
Musculoaponeurotic defect associated with bulge—group A	13 (59.1)
Only musculoaponeurotic defect—group B	3 (13.6)
Only lateral abdominal wall bulge—group C	6 (27.3)
Hernia classification[(2)]	
L2	2 (9)
L3	5 (22.7)
L4	5 (22.7)
Defect/bulge involving more than one area among L2, L3 and L4	10 (45.5)

Table 3 Surgical outcome

	Number (%)
SSO	
Cellulitis	0
Seroma	2 (9.1)
Hematoma	2 (9.1)
Skin dehiscence	1 (4.5)
Necrosis	0
SSI	0
Blood trasfusion	2(9.1%)
Chronic post-operative pain	0
Recurrence	1(4.5%)

the other patient required a readmission and surgical drain. Mesh removal or revision was not necessary. All complications are listed in Table 3**.**

The mean length of stay was 4.8 days (range 3–11). The mean follow-up duration was 44.8 months (range 5–92).

One recurrence (4.5%) was reported, specifically in a patient in group C with a previous Spigelian hernia repair, presenting a large lateral bulge due to denervation and halting gait because of poliomyelitis. At clinical evaluation at 1 year after surgery, an evident lateral bulge was present, albeit reduced in size.

All the other patients reported full satisfaction with the bulge correction.

No patient reported chronic post-operative pain.

Discussion

No best approach for lateral abdominal wall hernia repair has been described in the relevant literature, which consists of only case series, case reports, and retrospective studies with no formal comparison between open and laparoscopic techniques. There are no randomized trials that might provide the basis for strong recommendations to help surgeons in decision-making over these difficult hernias.

Lateral hernias present a challenge to the general surgeon because of (a) their anatomical location, which limits options available for adequate mesh overlap, and (b) the presence of bulges associated with true parietal defects in most patients.

Examining these patients' preoperative CT scans, there seemed to emerge some common features, regardless of defect size and the location of the true parietal defect. The muscles were often reduced in thickness and retracted, or "crinkled" (the rectus muscle medially and the oblique and transversus muscles laterally), thus making the entire lateral abdominal wall structure unstable. Moreover, the hernia defect often included more than one area: in our series, almost half of the patients (45.5%) had defects involving more than one area among L2, L3, and L4.

The risk of incarceration in flank or lumbar hernias is low (< 10%) because of the wide neck of the hernia orifice and the location within the abdominal wall itself [5]. However, these hernias may become more symptomatic as they grow larger over time. Surgical correction is, therefore, recommended when a patient presents with a symptomatic hernia.

Bulging of the lateral abdominal wall usually improves with hernia repair. However, surgery rarely results in exact symmetry with the contralateral side. Patients should have this expectation managed preoperatively.

The extraperitoneal technique for complex lateral hernia proposed in this paper is an evolution of the well-known concept of large mesh reinforcement in the preperitoneal plane, first described by Rives and Stoppa [11, 12] and later popularized by Wantz [13]. The function of the prosthesis is not to cover the defect but to make the peritoneum inextensible, thus avoiding recurrences.

Regardless of the mesh placement technique, it is generally recommended that the mesh area be much greater than the area of the hernia defect, i.e., the mesh should overlap the hernia defect by 5–10 cm in all directions [2, 3, 18, 20–22, 25]. Personally, we prefer a minimum overlap of at least 10 cm.

The bony landmarks (costal arch and iliac bone) are often too close to the hernia defect and are recognized by different authors [1, 4, 5] as the most difficult obstacle for a surgeon seeking to obtain a large pocket for the mesh with an adequate overlap. This obstacle results in a small prosthesis.

The importance of adequate mesh overlap in the repair of non-midline hernias has been demonstrated in cadaveric studies [14]. Since all synthetic mesh shrinks to some degree after placement, it seems unlikely that a prosthesis secured directly to the edge of the defect (rib or iliac crest) will result in a durable repair [4].

The importance of mesh overlap has been recognized by different authors. Phillips et al. [4] suggested that standard repair techniques often do not provide a long-term durable repair, as half of their patients had multiple recurrent hernias. The same was observed in our series of patients, 45% of whom reported one or more previous attempts at hernia repair. In all these cases, our intraoperative evaluation showed small pieces of prosthesis placed on a superficial layer (between external and internal oblique muscles or between internal oblique and transversus muscles).

Phillips et al. suggested a retrorectus–extrapreperitoneal mesh repair with transfascial suture fixation and, in cases where there was diminished overlap at the iliac crest due to bony loss, mesh fixation to the iliac crest. No evidence of hernia recurrence was reported, but unfortunately, the authors made no mention of the incidence of post-operative chronic pain.

In the literature, different planes for mesh placement have been proposed, such as external mesh onlay [15], intraperitoneal mesh underlay [16–18] (open or laparoscopic), or mesh between external and internal oblique layers [16, 17, 19, 20]

The technique proposed by Katkhouda [20] involves placing the mesh between the external oblique muscle and the internal oblique muscle and fixing it to a bony structure (the costal margin superiorly and the iliac crest inferiorly), and transfascially to the paraspinal muscles posteriorly and to the edge of the external oblique or the linea semilunaris anteriorly. They themselves recognized the cause of hernia recurrence in their first patient, as the mesh had not been affixed to bone superiorly and inferiorly. Unfortunately, these authors, too, made no mention of chronic post-operative pain, but they suggested that care should be taken to avoid the neurovascular bundle at the inferior border of the rib.

Nielsen et al. [21] proposed a peritoneal flap to bridge the fascial gap and placement of a mesh in the retrorectus space medially and the avascular plane between the internal and external oblique muscles laterally, with fixation of the mesh to the posterior musculo-fascial layer. In their series, one patient (1.3%) presented with a hernia recurrence, and at re-operation, the mesh was found to have become detached infero-laterally, likely due to inadequate dissection and insufficient mesh overlap. It was repaired by re-attaching the mesh, but the hernia recurred again within 1 year. They reported a chronic post-operative pain rate of 10%.

In our series, we proposed the extraperitoneal space, because it is the only one that allows dissection far beyond the bony prominences (see box 1). In this way, dissection has no physical limits.

The extensive mesh overlap made mesh fixation unnecessary: the prosthesis was pushed against the abdominal wall by the intra-abdominal pressure and, if we consider the definition of pressure as "the force exerted on a surface divided by the area on which this force acts", the greater the dimensions of the prosthesis (therefore, the surface on which the force acts), the lower the pressure to which the prosthesis is subjected. This reduces the theoretical possibility of mesh prolapse in the defect.

Avoiding mesh fixation, especially on the iliacus or psoas muscle, reduces the risk of post-operative pain [3, 4, 22].

We usually put two absorbable stitches (one on the pubic symphysis and the other on the xyphoid process) just to ensure delivery of the mesh in the right place and to avoid its dislocation during the abdominal wall closure step. Fibrin glue sprayed on the entire surface of the mesh may help to keep it in the right position. Moreover, fibrin glue seems to improve tissue integration compared with the traditional mesh fixation methods [23] and to reduce post-operative complications (i.e., abscessation/cellulitis, hematoma formation, and the need for blood transfusion) [24].

A further feature of our technique is that we extend the medial dissection beyond the linea alba, into the contralateral retrorectus–preperitoneal space. We do this, because, as previously explained, we believe that the entire lateral abdominal wall lacks stability and firmness and, to fix it, it is necessary to reach a virgin field able to support the prosthesis, i.e., the contralateral abdomen. In this way, transfascial medial mesh fixation can be avoided.

When performing this kind of extensive dissection, a deep knowledge of the anatomy of the region is mandatory. Major vascular structures are commonly encountered during the dissection, as well as key nerves of the region, such as the ilioinguinal, genitofemoral, and iliohypogastric nerves during their retroperitoneal course over the psoas muscle. Avoiding damage to these structures is important to reduce the risk of post-operative neuralgia or numbness. No such events were reported in our series, but patients must be warned about this possible long-term complication.

Studies, in human [25] and in animal models [26–28], have proved that abdominal wall stiffness increases with mesh weight. This outcome is often considered a disadvantage of this type of prosthesis, but in the type of patients considered in this study, it is important to try to reshape the lateral abdominal wall, in addition to repairing the hernia defect. This is the reason which we choose a heavyweight mesh.

Medium-weight mesh was instead used in thin patients presenting a true musculoaponeurotic defect and no abdominal wall bulging.

Our approach showed good results in terms of complications and recurrences over quite a long follow-up (mean 44.8 months). No major complications were recorded. Our post-operative seroma rate (9.1%) was similar to that reported in the literature (8–12.5%) [29, 30]. Moreover, the two cases of seroma were both evolutions of subcutaneous hematoma in patients on anticoagulant therapy. In their informed consent document, the increased risk of bleeding was specifically and expressly stated. Clearly, however, the risk of bleeding in these large dissections must always be kept in mind, patients must always be informed of it, and accurate hemostasis remains mandatory.

The only recurrence reported in this study occurred in a patient affected by a recurrent flank hernia with true musculoaponeurotic defect and bulge secondary to denervation. This patient had floppy paralysis of one leg as a result of poliomyelitis in childhood. The resulting severe scoliosis aggravated the lateral abdominal wall bulging. The patient was aware of the high risk of recurrence given the failure of previous surgery, and the presence of abdominal wall laxity and severe scoliosis. Probably, in this specific case, the indication for surgery was debatable.

Laparoscopy is described as less likely to lead to wound complications, morbidity, and recurrence, but no formal comparison has yet been made. On the contrary, an intra-abdominal approach requires extensive mobilization of the colon, increasing the risk of visceral injury [31]. These maneuvers are not necessary in open extraperitoneal approaches. The laparoscopic approach limits the mesh dimensions and makes extensive prosthesis fixation necessary, increasing the risk of complications.

For these reasons, some authors conclude that the laparoscopic approach should be limited to small defects where an adequate overlap can be achieved [1].

The open approach usually allows a better reapproximation of the fascial components, reducing the bulge effect; this is not possible with the laparoscopic approach. This advantage is to be kept in mind, since patients are frequently distressed by the unsightly bulge (27.3% in our series).

Robotic-assisted transabdominal preperitoneal flank hernia repair seems to be a promising technique, but, to date, only a few feasibility studies [5] have been published. It provides the benefits of both open and minimally invasive approaches, making it possible to place the prosthesis in an extraperitoneal space and suture the defect, reapproximating the edges, and reducing the bulge effect.

In conclusion, we believe that, regardless of the size and location of the defect, every complex lateral hernia requires the same extensive repair because of the critical anatomy of the region and the need to place a large medium–heavy-weight polypropylene mesh in an extraperitoneal plane, the only one that allows adequate coverage of the visceral sac.

Our technique is a safe, feasible, and reproducible treatment for this challenging surgical problem.

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Human and animal rights This study does not include any animal trial.

Informed consent For this type of article, informed consent is not required.

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