The endoscopic retromuscular approach (laparoscopic and robotic) of lateral abdominal wall hernias – a retrospective analysis from a single centre/single surgeon over 5 years

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DIANA TEODORA SUHACIU
ALEXANDRU LAURENTIU CHIOTOROIU
VICTOR GHEORGHE RADU
EMILIA VISILEANU
ALINA VLADU

ABSTRACT – REZUMAT

The endoscopic retromuscular approach (laparoscopic and robotic) of lateral abdominal wall hernias – a retrospective analysis from a single centre/single surgeon over 5 years

Lateral abdominal wall hernias account for approximately 1–4% of all surgical procedures for abdominal wall repair. The treatment of primary and incisional lateral abdominal wall hernias poses a challenge due to anatomical complexity, given the muscular stratigraphy, adjacent bony structures, and nervous elements, as well as technical difficulties in approach. Currently, there is no standardised surgical technique for the treatment of lateral hernias, with multiple approaches being presented: open, minimally invasive (laparo-endoscopic or robotic), or hybrid. Textile biomaterials are used as a biocompatible interface with the human body, in the form of medical devices, implants and prosthetic systems. The use of knitted biotextiles for non-implantable items and implants has developed greatly in the new field of tissue engineering. We present a 5-year retrospective study that includes cases of primary and incisional lateral abdominal wall hernias treated laparoscopically and robotically in the Centre of Hernia Surgery, Life Memorial Hospital, from June 2016 to December 2022. The study included 24 patients with primary and incisional hernias resolved laparoscopically (eTEP-TAR, eTEP) and 5 cases resolved robotically. The majority of the cases (80.8%) of lateral hernias are incisional; 38.5% are strictly lateral hernias, with the rest having a median component. In the laparoscopic group, eTEP-TAR was performed in 21 cases, and eTEP in 3 cases. In the 5 cases of surgery performed robotically, eTEP-TAR was carried out. No cases of conversion were recorded. For the patients operated on laparoscopically: there was one incident of small bowel injury during adhesiolysis, which was resolved during the same surgical session (with laparoscopic suture). No complications were reported in the group of patients operated on robotically. The average postoperative hospitalisation time was 39 hours. The average follow-up period was 4 years and 6 months, with no complications or recurrences. The eTEP-TAR technique for repairing lateral hernia cases (incisional and primary) is difficult and complex; however, the results are very good if performed correctly, whether laparoscopically or robotically, as demonstrated by the reduced hospital stay, low level of postoperative pain, and rapid recovery of the patients.

Keywords: *robotic eTEP-TAR, abdominal wall reconstruction, incisional hernia, lateral hernia, laparoscopic eTEP abdominal wall reconstruction, textile biomaterials*

Abordarea endoscopică retromusculară (laparoscopică și robotică) a herniilor laterale ale peretelui abdominal – o analiză retrospectivă realizată de un singur centru/un singur chirurg pe o perioadă de 5 ani

Herniile laterale ale peretelui abdominal reprezintă aproximativ 1–4% din toate intervențiile chirurgicale pentru repararea peretelui abdominal. Tratamentul herniilor laterale primare și incizionale ale peretelui abdominal reprezintă o provocare datorită complexității anatomice, având în vedere stratigrafia musculară, structurile osoase adiacente și elementele nervoase, precum și dificultățile tehnice în abordare. În prezent, nu există o tehnică chirurgicală standardizată pentru tratamentul herniilor laterale, existând multiple abordări: deschisă, minim invazivă (laparo-endoscopică sau robotică) sau hibridă. Biomaterialele textile sunt utilizate ca interfață biocompatibilă cu corpul uman, sub formă de dispozitive medicale, implanturi și sisteme protetice. Utilizarea biotextilelor tricotate pentru articole neimplantabile și implanturi s-a dezvoltat foarte mult în noul domeniu al ingineriei tisulare. Prezentăm un studiu retrospectiv pe 5 ani care include cazuri de hernii abdominale laterale primare și incizionale tratate laparoscopic și robotic în Centrul de Chirurgia Herniilor, Life Memorial Hospital, din iunie 2016 până în decembrie 2022. Studiul a inclus 24 de pacienți cu hernii primare și incizionale rezolvate laparoscopic (eTEP-TAR, eTEP) și 5 cazuri rezolvate robotic. Majoritatea cazurilor (80,8%) de hernii laterale sunt incizionale; 38,5% sunt hernii strict laterale, restul având o componentă mediană. În grupul laparoscopic, tehnica eTEP-TAR a fost efectuată în 21 de cazuri, iar eTEP în 3 cazuri. În cele 5 cazuri de intervenții chirurgicale realizate robotic, s-a efectuat eTEP-TAR. Nu s-au înregistrat cazuri de conversie. Pentru pacienții operați laparoscopic: a existat un incident de leziune a intestinului subțire în timpul adeziolizei, care a fost rezolvat în timpul aceleiași sesiuni chirurgicale (cu sutură laparoscopică). Nu au fost raportate complicații în grupul de pacienți operați robotic. Durata medie de spitalizare postoperatorie a fost de 39 de ore. Perioada medie de urmărire a fost de 4 ani și 6 luni, fără complicații sau recidive. Tehnica eTEP-TAR pentru repararea cazurilor de hernie laterală (incizională și primară) este dificilă și complexă; cu toate acestea, rezultatele sunt foarte bune dacă este efectuată corect, fie laparoscopic, fie robotic, așa cum demonstrează durata redusă de spitalizare, nivelul scăzut al durerii postoperatorii și recuperarea rapidă a pacienților.

Cuvinte-cheie*: eTEP-TAR robotic, reconstrucție a peretelui abdominal, hernie incizională, hernie laterală, reconstrucție laparoscopică a peretelui abdominal eTEP, biomateriale textile*

INTRODUCTION

Lateral abdominal wall hernias, both primary and incisional, are less common than medial hernias [1]. Primary lateral hernias (Spigelian hernia) and lumbar hernia (Grynfeltt or Petit) represent 2% of total ventral hernias [2], and incisional hernias depend on the incision made during the initial surgery, subcostal or lumbar incision. Usually, many surgeons operate on lateral hernias using an open approach, but minimally invasive techniques (MIS) (laparo-endoscopic or robotic) are gaining an important place in the surgical arsenal.

Surgical repair of lateral hernias using MIS techniques is challenging for the surgeon due to the proximity of bony structures (the costal margin and iliac crest) and limited access possibilities, the specific position of the patient (lateral or semi-lateral decubitus), special instruments, and the advanced technical skills required for the surgery. Associated paresis of the abdominal wall as a result of muscle denervation is an additional challenging factor that drastically affects postoperative outcomes [3].

According to the classification by the European Hernia Society (EHS), lateral hernias are classified as shown in figure 1: L1 subcostal (between the costal margin and a horizontal line 3 cm above the navel), L2 flank (lateral to the straight abdomen in the area 3 cm above and below the navel), L3 iliac (between the line 3 cm below the navel and the inguinal region), and L4 lumbar (laterodorsal from the anterior axillary line) [4].

Lateral hernias are often associated with medial ones, especially incisional hernias. For this reason, the approach varies depending on each case.

The eTEP-TAR technique (eTEP: enhanced view extraperitoneal, TAR: transversus abdominis release) has proven to be feasible in repairing primary and incisional midline hernias, and for repairing lateral ones, it is necessary to perform TAR at least on the side of the hernia [5–7].

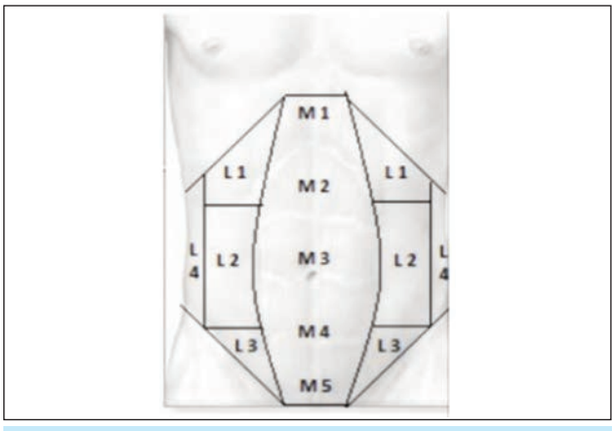

Fig. 1. Classification of incisional hernias by location, according to the EHS guidelines (M – Median, L – Lateral)

The constant interest in the use of biomaterials in surgery is due to the continuously improved properties of biomaterials and the possibility of performing increasingly complex surgical interventions with higher success rates. A surgical mesh is defined as a material network with a grid-like structure that, in medicine, has become synonymous with its use in repairing parietal defects [8]. Surgical meshes can be made from absorbable or non-absorbable materials. Non-absorbable meshes can meet mechanical requirements, are easy to shape during surgery, and have long-term stability. However, complications such as rigidity, recurrence, mesh erosion, and adhesion have been documented. On the other hand, absorbable meshes were developed to reduce long-term complications. These meshes promote the activity of fibroblasts postoperatively. Polylactic acid (PLA) is a material commonly used for soft tissue repair, with a slow degradation rate and stable mechanical properties over short periods. PLA-based composite materials are used both in the pelvic area and in areas affected by hernia. However, after the prosthesis is absorbed, the resulting scar tissue is no longer as strong as it initially was and is not sufficient to provide the necessary support, which can lead to recurrences [9].

This article is a preview and, after gathering a significantly larger number of robotically operated cases, a comparison can be made. Furthermore, it does not aim to compare the two groups of cases (patients operated on robotically and laparoscopically) precisely due to the small number of cases. Additionally, we clarify that we do not intend to describe the eTEP/eTEP-TAR surgical technique, as it has already been a surgical method practised for 8 years, especially in centres dedicated to parietal surgery.

We did not consider it necessary to characterise each case of incisional hernia regarding previous interventions, but following the classification of complex cases according to the definition, the decision was made for them to be performed robotically, while those with reduced complexity were performed laparoscopically.

MATERIAL AND METHOD

Patients

We conducted a retrospective follow-up study of consecutive patients who underwent abdominal wall reconstruction with prostheses for primary or incisional lateral hernias between June 2016 and December 2022. The primary authors of the paper conducted the follow-up examination. All included patients were over 18 years old with primary or recurrent incisional hernias and agreed to participate after giving informed consent. Umbilical hernias, trocar incisional hernias, emergency cases, and parastomal hernias were excluded. Additionally, patients who refused to participate in this study were excluded.

Written informed consent was obtained from each patient. The study was conducted with the approval of the Local Ethics Committee. Demographic data (age, gender, ASA classification, BMI, comorbidities) and hernia characteristics (previous hernia repair, defect location, size and area, type of procedure)

were recorded from the data files. All patients underwent a preoperative native abdominopelvic computed tomography (CT) scan to evaluate hernia characteristics (length, width, area and volume of the incisional hernia sac and the peritoneal cavity), presence of mesh (if previously inserted), and the measurements of the abdominal wall muscles (width of the rectus muscle for assessing the retro-rectal space, width, and length of the lateral muscles).

Surgical procedure

All patients received antithrombotic prophylaxis according to the anaesthesia and intensive care protocol. Preoperatively, when the Sabbagh index was greater than 0.25, the abdominal wall was optimised by intramuscular injection with botulinum toxin A (Dysport™ Ipsen Pharma 500 IU) according to the Ibarra-Hurtado technique [10]. Dysport was administered 4 to 6 weeks preoperatively to achieve the maximum effect of muscle relaxation. When larger defects were associated with hernia irreducibility, Progressive Preoperative Pneumoperitoneum (PPP) was performed according to the classical technique previously described by Goni Moreno [11]. The duration and volume of air insufflated are variable depending on the local conditions.

All surgical repairs were performed under general anaesthesia by the same surgeon (Dr. Victor Radu), following the techniques described by Igor Belyansky [5] (figures 2–7). The abdominal wall was reinforced intramuscularly with a monofilament polypropylene prosthesis medium-weight microporous mesh. The surface area of the installed mesh exceeded the area of the defect by more than three times, respecting the principles of the Mesh Defect Area Ratio (MDAR).

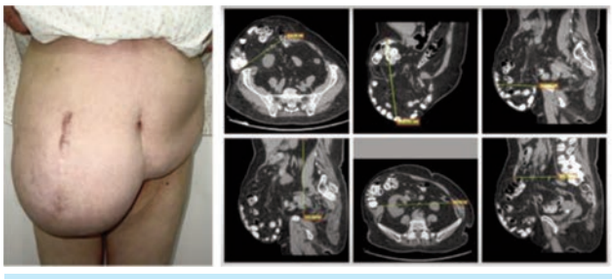

Fig. 2. Right pararectal incisional hernia with loss of domain (L3W3. LOD)

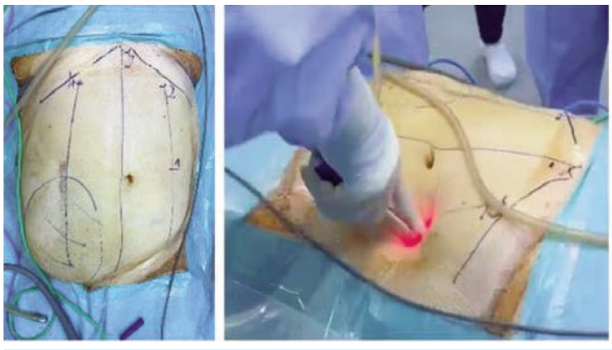

Fig. 3. Optical trocar approach to the retro-muscular space of the rectus abdominis on the left side

Active mobilisation was encouraged from the first hours postoperatively, and the resumption of oral feeding depended on individual digestive tolerance.

During the referred period, 157 patients with various types of incisional hernias were admitted and operated on. Of these, 29 met the inclusion criteria, agreed to participate, signed the informed consent, and were included in the study. The majority of the patients were obese, with 14 of them having a BMI over 30 kg/m² (tables 1–3).

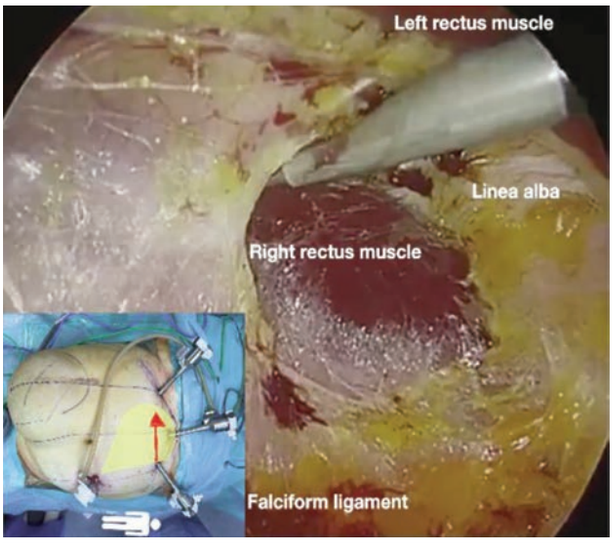

Fig. 4. Crossing of the linea alba anterior of the falciform ligament

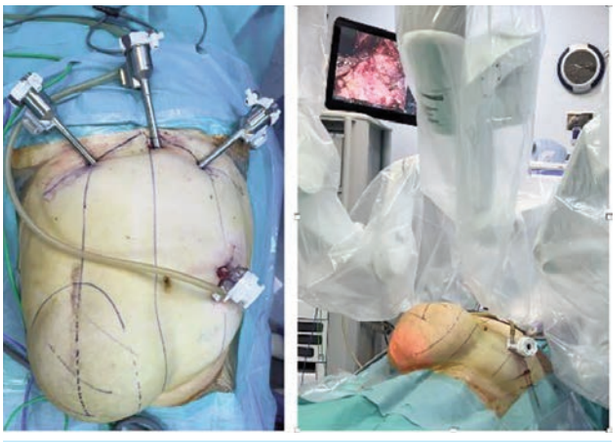

Fig. 5. Subcostal trocarization and robot docking

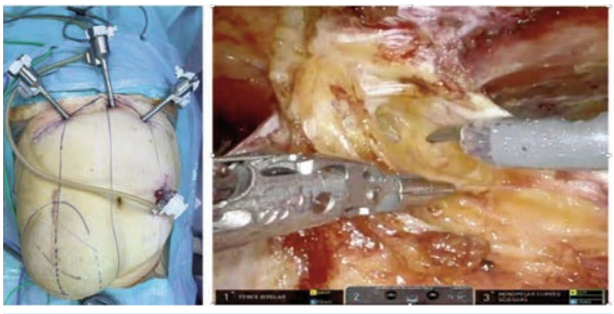

Fig. 6. Retro-muscular dissection by incising the posterior sheaths of the rectus abdominis on their medial edge

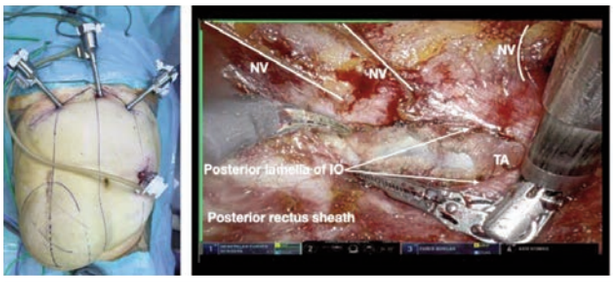

Fig. 7. Identification of anatomical landmarks for TAR

Table 1

DEMOGRAPHIC DATA, COMORBIDITIES, AND PREOPERATIVE CHARACTERISTICS – LAPAROSCOPIC PATIENT GROUP	
Characteristic	**Value**
Patients	n=24
Age (years)	56.50 ± 10.62 (SD)
Male/Female	62.5%/37.5%
ASA Score	2.17 ± 0.7 (SD)
BMI	30.7 ± 5.26 (SD)
Smoker	25%
Dyslipidemia	62.5%
HTA under treatment	41.7%
Diabetes mellitus	29.2%
Coronary disease	12.5%
History of cancer	12.5%

Table 2

LOCALIZATION OF DEFECT HERNIA – LAPAROSCOPIC PATIENT GROUP	
Defect hernia	**No Cases (procent)**
Lateral	10 (41.7%)
Multiple sites	14 (58.3%)

Table 3

DEMOGRAPHIC DATA, COMORBIDITIES, AND PREOPERATIVE CHARACTERISTICS – ROBOTICALLY OPERATED PATIENT GROUP	
Characteristic	**Value**
Patients	n=5
Age (years)	52.6 ± 6.98 (SD)
Male/Female	20%/80%
ASA Score	2 ± 0.54 (SD)
BMI	30.2 ± 4.87 (SD)
Smoker	40%
Dyslipidemia	20%
HTA under treatment	60%
Diabetes mellitus	20%
Coronary disease	40%
History of neoplasm	40%

As a result of this study, a retrospective analysis was conducted on a group of 29 patients who underwent both laparoscopic and robotic surgery for primary and lateral incisional hernias over approximately 5 years (June 2016 – December 2022) at the Abdominal Wall Surgery Centre, Life Memorial Hospital, Medlife, Bucharest.

Within the studied group, 24 patients with lateral abdominal wall hernias, both primary and incisional (some also having a median component), were treated laparoscopically (eTEP-TAR, eTEP), and 5 patients were treated robotically.

Textile biomaterials

The use of knitted biotextiles for non-implantable items and implants has developed greatly in the new field of tissue engineering.

In all surgical repairs, the main mesh was the Parietene macroporous mesh. It is a polypropylene macroporous mesh with large pores (2.0 × 2.4 mm) and has the right balance between rigidity and softness.

The mesh placement into the retrorectus space was done after measurement of the entire area which will be covered by the mesh. The surface covered by the mesh is not the surface of the defect; it is the entire dissected area.

Patients operated laparoscopically

The group of patients who underwent laparoscopic surgery consisted of 16 men and 8 women, with an average age of 55 years, an average BMI of 30 (ranging from 22 to 45), and an average ASA score of 2. Out of the total 24 cases, 21 had incisional hernias, 2 patients had post-traumatic hernias, and there was one mixed case (lateral incisional hernia and inguinal hernia).

Ten of the 24 patients who underwent laparoscopic surgery had only lateral abdominal wall defects (table 4).

Table 4

LOCATION OF HERNIA DEFECTS – ACCORDING TO EHS CLASSIFICATION – PATIENTS MANAGED LAPAROSCOPICALLY			
Localization	**Number of cases**	**Localization**	**Number of cases**
L1	4	M1	5
L2	10	M2	6
L3	11	M3	9
L4	3	M4	5
-	-	M5	1

The diameter of the lateral defects ranges between 3 and 15 cm, with an average of 6 cm. Seven patients from the laparoscopically operated group met the criteria defining a complex case of abdominal hernia. Thus, the 7 cases consist of recurrent hernias,

including 5 cases with a defect diameter greater than 10 cm. Two cases have a BMI over 40.
Within the described surgical procedures, among the 10 cases of strictly lateral hernias, there were 3 cases where eTEP was performed without the need for posterior component separation using TAR: one case of L4 lumbar incisional hernia, one case of right iliac fossa L3 incisional hernia, and one case of post-traumatic L4 lumbar hernia. In the other 7 hernia cases, a unilateral eTEP-TAR was performed (table 5). For patients with a lateral hernia associated with a defect on the midline (14 cases), eTEP-TAR was performed (unilateral posterior component separation with TAR in 5 cases and bilateral TAR in 9 cases) (figures 8–11).

Table 5

LAPAROSCOPICALLY PERFORMED INTERVENTIONS		
	Number of patients	**Procent (%)**
eTEP	3	12.5
eTEP- TAR unilateral	12	50
eTEP-TAR bilateral	9	37.5

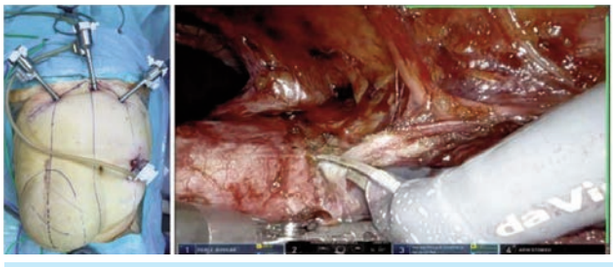

Fig. 8. TAR on the right side

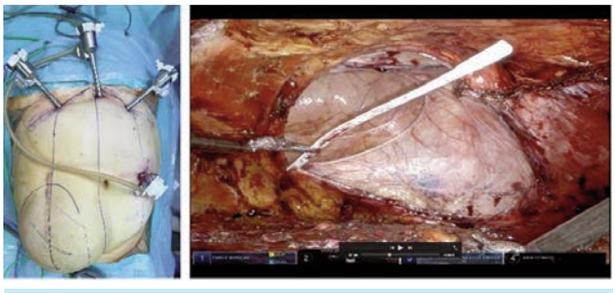

Fig. 9. Hernia reduction and defect measurement

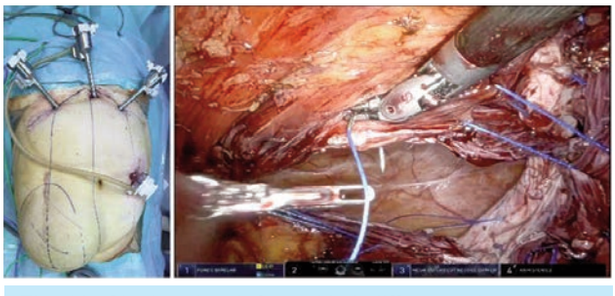

Fig. 10. Closing the defect with 3 different wires, placed in a “Mercedes star”

Fig. 11. Retro-muscular prosthesis

RESULTS AND DISCUSSION

The average operative time for eTEP interventions is 118 minutes (with a minimum of 65 minutes and a maximum of 175 minutes). For eTEP-TAR interventions, the average operative time was 280 minutes (with a minimum of 100 minutes for right L3W2 incisional hernia and a maximum of 510 minutes for a complex right L123 W3 M1W1 R1 case).
When unilateral TAR was performed, the average operative time was 245 minutes, whereas for bilateral TAR, the average time was 330 minutes (minimum 220 minutes and maximum 510 minutes).
No conversions to open surgery were recorded.
The average postoperative hospital stay was 39 hours (ranging from 18 to 163 hours). For patients who underwent eTEP, the average hospital stay was 20 hours, whereas for those who underwent eTEP-TAR, the average was 42 hours. The average number of doses of analgesics administered postoperatively was 2 doses.
An intraoperative incident was reported, involving a serosal injury of the bowel, which was laparoscopically sutured during the operation, and a postoperative event, where one case developed therapeutic erythema on the thorax, which resolved without any correlation to the surgical intervention performed.
The average follow-up period is 4 years and 6 months, conducted via telephone follow-up and physical examination when necessary; no cases of chronic pain or hernia recurrence were recorded.

Robotically resolved cases

The group of patients operated on robotically includes one man and four women, with an average age of 52 years, an average BMI of 30 (ranging from 22.3 to 35.6), and an average ASA score of 2. All five cases involved incisional hernias, both with lateral and medial components, including two cases of incarcerated hernias and one case of recurrent R1 hernia. The defect diameter ranged from 3 to 15 cm. Three patients met the criteria for complex cases [12]: patients with an average defect diameter of 10 cm.
There were no intraoperative or postoperative complications in the robotically operated group. The average postoperative hospital stay was 36 hours (ranging from 17 to 86 hours), and the average number of doses of usual non-morphine analgesics administered postoperatively was 4 doses. Patients were followed for an average period of 13 months, with no

recorded postoperative complications, chronic pain, recurrence, or mortality was zero.

An attempt to compare the two groups does not provide statistical validation due to the heterogeneity of the cases and the small number of patients operated on robotically. A longer operative time can be observed in the robotic group, most likely due to the greater complexity of the cases, but there is a similarity in the postoperative outcomes (hospital stay duration, postoperative complications).

Performing robotic interventions has been in our clinic and practice for approximately 2 years, which is why the follow-up period for the patients is limited.

CONCLUSIONS

The endoscopic approach for lateral hernias using the eTEP/eTEP-TAR technique is both feasible and safe, ensuring a short hospital stay, a low level of postoperative pain, and rapid recovery. It is difficult to analyse the impact of robotic surgery due to the limited number of cases (initial experience and low incidence of lateral hernias). However, considering that predictably difficult and complex cases were selected for robotic surgery, and the study data at least show comparable results with laparoscopic surgery, the positive impact of robot-assisted surgery in abdominal wall reconstruction can be appreciated.

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Authors:

DIANA TEODORA SUHACIU[1,2], ALEXANDRU LAURENTIU CHIOTOROIU[3], VICTOR GHEORGHE RADU[4], EMILIA VISILEANU[5], ALINA VLADU[5]

[1]Center of Hernia Surgery, Life Memorial Hospital, Bucharest, Romania

[2]UMF Carol Davila, Bucharest, Romania

[3]Department of General Surgery, Emergency Clinical, Hospital of Bucharest, Bucharest, Romania

[4]Center of Hernia Surgery, Life Memorial Hospital, Bucharest, Romania

[5]National Research and Development Institute for Textiles and Leather, Bucharest, Romania

Corresponding author:

VICTOR GHEORGHE RADU
e-mail: dr.victor.radu@gmail.com