

## Research Article

# Laparoscopic Repair with Mesh Reinforcement is a Good Alternative for the Epigastric Hernia: Aretrospective Study Comparing Laparoscopic with Open Repair

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## Abstract

**Background:** Epigastric hernias may lead to discomfort and pain. The mainstay of treatment is surgical repair with mesh reinforcement. The primary aim of this study was to compare recurrence rate of Laparoscopic Epigastric Hernia Repair (LEHR) versus conventional Open Epigastric Hernia Repair (OEHR) with mesh reinforcement. Secondary aims were to evaluate perioperative outcomes and quality of life.

**Methods:** Ninety-nine patients (58% female) from two non-academic hospitals were retrospectively reviewed. The Short-Form-36 Health Survey questionnaire and the Carolina Comfort Scale were used to assess quality of life and complaints related to mesh implantation.

**Results:** Forty-two (42%) patients underwent LEHR, and 57 (58%) underwent OEHR. Mean follow-up at the outpatient clinic was 7.1 months in the LEHR group, and 8.1 months in the OEHR group. Mean follow-up by telephone contact was 67.8 months in OEHR group and 58.1 months in LEHR group. The risk of recurrence appeared to be slightly lower for LEHR (2%) compared to OEHR (7%) ( $p=0.298$ ). Median surgical duration was 54 minutes in the LEHR group and 28 minutes in the OEHR group ( $p<0.001$ ). Median hospitalization time was 1 day in the LEHR group and 0.5 day in the OEHR group ( $p<0.001$ ).

**Conclusion:** Laparoscopic hernia repair was associated with a lower risk of recurrence, although this did not reach statistical significance. Despite the fact that surgical duration appeared to be longer for the LEHR group, the postoperative outcomes were similar between groups, making laparoscopic repair a good alternative compared to the open approach for epigastric hernias.

**Keywords:** Epigastric hernia; Herniorrhaphy; Laparoscopic; Open; Recurrence; Surgical approach

## Introduction

Epigastric hernia refers to herniation of the abdominal wall cranially to the umbilicus, up to the xiphoid. Epigastric hernia represents 1.6% to 3.6% of all abdominal hernias and embodies 0.5% to 5% of all operated abdominal hernias [1]. Patients with an epigastric hernia can experience pain or discomfort. The size of the herniated sack may increase over time, increasing the risk of complaints. Moreover, abdominal wall hernias are associated with severe complications due to the risk of incarceration of abdominal contents such as bowel, fat or omentum, which might induce necrosis and occurs within 4-6 hours depending on the mesenteric blood flow [2-6].

Traditionally, hernia repair was performed through an open surgical approach, either through primary closure or with mesh reinforcement [7-13]. Laparoscopic Epigastric Hernia Repair (LEHR)

was presented as an alternative technique to Open Epigastric Hernia Repair (OEHR) in 1992 and has been used increasingly over the last decades [14]. Some evidence supports that LEHR with a mesh is beneficial over OEHR with a mesh in terms of complications like surgical site infection and recurrence, hospital stay, institutional costs [9,15-22]. These benefits could be due to the fact that LEHR is minimally invasive, subsequently aiding in less postoperative complications, increased mesh comfort and lower recurrence rates due to implementation and fixation via the laparoscopic route, avoiding minimal overlap and concomitant hernias [16,19]. Laparoscopic ventral wall hernia repair has been regarded as a safe alternative to open repair [15]. However, previous studies pooled all ventral wall hernias (i.e., umbilical, incisional and epigastric) [10,14-16,18,20]. Kockerling et al. [23] showed that the different types of hernias require different treatment since postoperative outcomes differ between hernias with the same operation technique. Therefore, it could be stated that studies comparing various surgical techniques should only be conducted for a single hernia type. To date, there is little evidence to support the use of either LEHR or OEHR with mesh implementation for solely epigastric hernia repair.

The aim of this retrospective study is to compare outcomes of laparoscopic and open primary epigastric hernia repair with regard to recurrence risk, mesh-related complaints, quality of life, and postoperative complications.

## Methods

This study was conducted according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)

**Citation:** den Dop L M, de Smet GHJ, Bus MPA, Lange JF, Huetting WE. Laparoscopic Repair with Mesh Reinforcement is a Good Alternative for the Epigastric Hernia: Aretrospective Study Comparing Laparoscopic with Open Repair. *Int J Minim Access Surg.* 2020;1(1):1007.

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**Publisher Name:** Medtext Publications LLC

**Manuscript compiled:** July 03<sup>rd</sup>, 2020

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recommendations for observational studies [24], the Strengthening of Reporting of Cohort Studies in Surgery (STROCCS) criteria [25], and The EuraHS Working Group (European Registry of Abdominal Wall Hernias) [26].

### Study design

Adult patients undergoing primary epigastric hernia repair via LEHR or OEHR with mesh reinforcement between 2012 and 2017 in two non-academic teaching hospitals were included and analyzed retrospectively.

### Patient selection

Patients were first seen at the outpatient clinic by the surgeon, who performed physical examination and preoperative workup. An epigastric hernia was defined as a primary ventral hernia close to the midline with its centre above the umbilicus. In case of any doubts about the diagnosis, or to help plan for the surgical approach and management, ultrasound or Computed Tomography (CT) scan was performed. Selection for the operation technique was made in collaboration by the surgeon and the patient. This shared-decision making consisted of clarifying the advantages and disadvantages of both procedures, and possible complications with respect to patient and hernia characteristics (size of defect and contents of the hernia) to ensure choosing the correct tailored approach for each individual patient. The surgeon opted for a laparoscopic approach if the patient had a Body Mass Index (BMI) >30, and if the patient indicated that cosmetic outcome was important.

Two groups were defined:

- Patients undergoing LEHR
- Patients undergoing OEHR

### Data collection

The surgeon, fixation type, type of anesthesia, operation time, Visual Analogue Scale (VAS) for pain within the first 24 hours after surgery, complications, hospitalization time and hernia recurrences were all retrospectively extracted from medical charts for both LEHR and OEHR groups. Patient groups were compared to address potential sources of bias in baseline characteristics that consisted of gender, age, BMI, smoking, corticosteroid use, diabetes, chronic lung disease, American Society of Anesthesiologists (ASA) classification [27], defect size, operation time and hospitalization time.

### Surgical technique

Both LEHR and OEHR were conducted under general anesthesia. Additionally, some patients, albeit in both groups, had a Transverse Abdominis Plane (TAP) block [28]. The TAP block was introduced in 2015 in both hospitals. The choice of anesthesia depended on the preference of the anesthesiologist, and was therefore not used in every patient after 2015.

For LEHR, a Veress needle was introduced in the intra-abdominal space through insertion in the left subcostal or hypochondriac region to achieve pneumoperitoneum. Adhesiolysis was performed around the defect, and contents of the hernia sac were retracted back into the abdomen. The hernia sac was dissected with the use of diathermy. When the defect was greater than one centimetre, the defect was closed prior to mesh placement with the use of an Endo Stitch (Medtronic, Minneapolis, MN, USA). The mesh was fixated with a minimal overlap of 4 cm to 5 cm (centimetres) using sutures through

the mesh against the abdominal wall with four resorbable polyglactin (Vicryl; Ethicon USA) sutures in all four edges with the use of an Endo Close™ grip (Medtronic, Minneapolis, MN, USA), or a single or double crown technique (depending on the surgeon's preference) with tackers (Sorbafix™ (BARD inc, Warwick, UK) on the abdominal wall.

For OEHR, the position and sterilization of the patient were equal to that of the LEHR. A vertical incision was made in the length of the hernia, and dissection through the subcutaneous fat was carried out with caution to avoid enterotomies. The hernia sac was identified and the hernia defect was measured. An apt mesh size was placed in a preperitoneal manner and a correct overlap of minimally 3 centimetres in all directions was ensured. The mesh was fixated with non-resorbable polypropylene (Prolene; Ethicon USA) or resorbable polyglactin (Vicryl; Ethicon USA) sutures, and the fascia was closed with polyglactin sutures.

### Postoperative follow-up

All patients were seen at the outpatient clinic at three to four weeks postoperatively. After this one-time follow-up, patients were usually discharged from follow-up and were instructed to return if new complaints emerged. Hernia recurrences were assessed at the follow-up appointments in the outpatient clinic by the surgeon who operated the patient, or an attending resident. The assessment consisted of patient complaints, physical examination and Valsalva's manoeuvre. Hernia recurrence was defined as a protrusion of the contents of the abdominal cavity or preperitoneal fat through a defect in the abdominal wall at the site of a previous repair of the epigastric hernia. When there were any doubts about the diagnosis of hernia recurrence during clinical examination, ultrasound or CT scan was performed. The site and size of the recurrent hernia were recorded in medical charts.

All included patients were contacted in 2019 by phone to ask whether they had abdominal complaints and were asked to fill out two questionnaires and to return the questionnaires by mail: The Dutch language version of the Short-Form-36 (SF-36) Health survey [29], and Carolina Comfort Scale (CCS) [30,31].

The SF-36 Health Survey consists of a physical and mental component scale ranging from 0 to 100. The scores were compared to those of the average Dutch population. The CCS was used to assess mesh-related complaints in various activities up to a scale from 0 to 5. Scores of 0 and 1 were considered asymptomatic, and scores of 2 or higher were considered symptomatic. Complications were grouped according to the Clavien-Dindo Classification of Surgical Complications [32].

### Statistical analysis

Categorical variables were compared between groups using chi-square tests; numerical variables were compared using Mann-Whitney U tests. Continuous variables are presented as means with corresponding Standard Deviations (SD). Categorical variables are presented as absolute numbers and percentages. Differences in yearly mean of hospitalization time were assessed with a two-way ANOVA test. Operation time, CCS and SF-36 scores were analyzed with the use of independent t-tests. Outcomes are expressed in 95% Confidence Intervals (CIs). All statistical analyses were performed using SPSS version 26 (IBM corp. Released 2019. IBM SPSS Statistics for Windows, version 26.0 IBM Corp, Armonk). P-values of <0.05 were considered statistically significant.

## Results

A total of 164 patients underwent primary epigastric hernia repair. Sixty-one patients underwent surgical repair without mesh implementation and were excluded from the study. After obtaining institutional ethics board approval, the remaining 103 patients were contacted. Four patients chose not to participate in the study because of privacy reasons, leaving 99 patients for review. Forty-two patients (42%) were treated with LEHR, and 57 (58%) were operated with OEHR. A flow diagram of the patient selection is shown in Figure 1.

### Baseline characteristics

The LEHR group consisted of 13 (31%) male patients, and 29 female (69%) patients. In the OEHR group there were 29 males (51%) and 28 females (49%). Difference in gender between groups was statistically significant ( $p=0.047$ ) (Table 1). Mean age in the LEHR group was 52 years, vs. 49 years in the OEHR group ( $p=0.270$ ). Smokers were less prevalent in the LEHR group (6 vs. 17,  $p=0.003$ ).

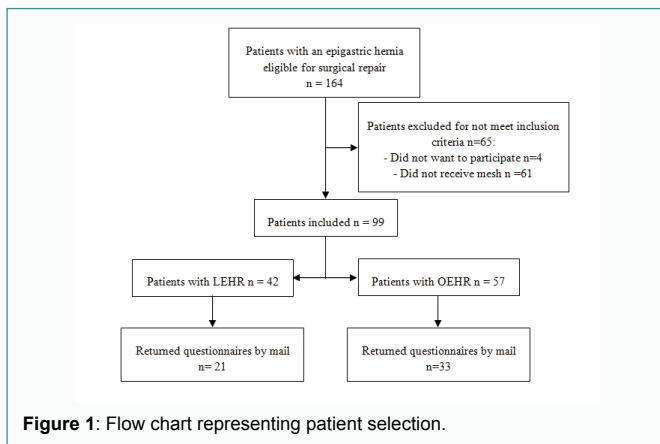


Figure 1: Flow chart representing patient selection.

Table 1: Patient baseline characteristics for patients with an epigastric hernia undergoing surgical repair.

	OEHR (n=57)	LEHR (n=42)	P-value	Missing n°
<b>Sex</b>			0.047	
Male	29 (51)	13 (31)		
Female	28 (49)	29 (69)		
<b>Age (years)</b>	49 (14.0)	52 (13.4)	0.270	
<b>Smokers</b>	17 (29)	6 (14)	0.003	27
<b>Chronic lung disease</b>	7 (12)	7 (17)	0.536	
<b>Corticosteroid use</b>	3 (5)	3 (7)	0.698	
<b>Diabetes</b>	4 (7)	2 (5)	0.642	
<b>BMI (kg/m<sup>2</sup>)</b>	27 (5.2)	26 (6.0)	0.506	
<b>ASA classification</b>			0.65	
I	26 (46)	15 (36)		
II	28 (49)	24 (57)		
III	3 (5)	1 (2)		

ASA: American Society of Anaesthesiologist; BMI: Body-Mass-Index; TAP: Transverse Abdominal Plane. Continuous variables are presented a mean and SD. Discrete variable are presented as absolute number and (percentage). P-value for categorical data was calculated with Chi-square tests, continues data with an independent t-test.

### Hernia recurrence

In the LEHR group there was one patient (2.3%) who developed a recurrence after 12 months, and in the OEHR group there were four patients (7.4%) who developed a recurrence after a median follow-up of 6 months (Table 2). This difference in recurrence did not reach statistical significance ( $p=0.298$ ).

## Complications

Following the Clavien-Dindo Classification, there were four grade I complications (9.5%) and three grade II (7.1%) complications in the LEHR group, vs. two grade I complication (3.7%), and one grade II (1.8%) complication in the OEHR group (Table 3). No grade >II complications were observed. The grade I complications consisted of postoperative pain requiring additional analgesia (oxycodone or celecoxib) for a maximum of 4 weeks, except for one patient who remained having atypical abdominal pain complaints and taking analgesia for 6 months. One patient developed a seroma, without the need of drainage, and recovered the next week. Grade II complications consisted of two antibiotic treatments for pneumonia, two antibiotic treatments for wound infections, and one case in which the patient who also had pneumonia developed acute kidney insufficiency of unknown cause postoperatively, which had to be monitored at the ICU for one night, but recovered the next day. Overall morbidity was low; the majority of patients could retake their normal activities within a month without complaints. There were no perioperative deaths. An overview of the complications is presented in Table 3.

### Operation and hospitalization time

Operation time differed significantly in favour of the OEHR group (mean 57 vs. 32 min,  $p<0.001$ ), seen in Table 2. The LEHR group had a mean hospitalization time of 2.0 days (range: 15-0.5 days) and the OEHR group had a mean hospitalization time of 0.7 days (range: 3-0.5 days,  $p<0.001$ ). For each year, the mean days of hospitalization is calculated for both groups (Figure 2). In the LEHR group, the mean hospitalization time is declining each year except for 2015. The yearly mean hospitalization time of the OEHR seemed to stay at an even level.

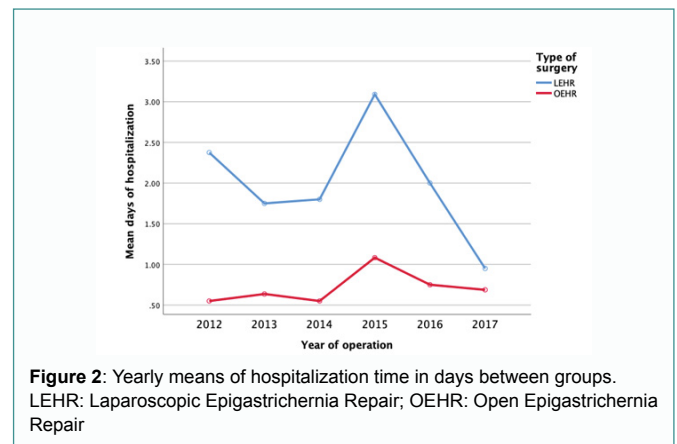


Figure 2: Yearly means of hospitalization time in days between groups. LEHR: Laparoscopic Epigastrichernia Repair; OEHR: Open Epigastrichernia Repair

### Follow-up by telephone, SF-36 health survey and carolina comfort scale

Of all patients contacted, three patients (one LEHR and two OEHR) reported still having abdominal discomfort after a median of 76.0 months. One of these patients, one had a recurrence which was operated again, one patient had a cholecystectomy 4 months after hernia surgery, and one patient did not return to the outpatient clinic, despite having abdominal discomfort.

Of the 99 patients included in the study, 53 (54%) patients returned the questionnaires (Figure 1). CCS scores in the LEHR group found five patients (24%) to have symptomatic mesh-related complaints. In the OEHR group, a total of seven (22%) patient reported symptomatic complaints ( $p=0.87$ ) (Table 4).

Postoperative scores on the SF-36 Health Survey found that the perceived health in terms of Mental Component Scale (MCS) and Physical Component Scale (PCS) after both operations was higher than the average Dutch population. The average MCS and PCS of the Dutch population was 50.0. The LEHR group scored slightly lower than the OEHR group in terms of MCS (52.2 vs. 55.8,  $p=0.20$ ) and PCS (50.2 vs. 52.2,  $p=0.55$ ) (Table 4).

## Discussion

In most studies, all the different ventral wall hernia types are pooled, and little evidence is known about the management of solely primary epigastric hernias [9]. To date, there are no randomized control trials or comparative studies that compare the outcomes of laparoscopic and open primary epigastric hernia repair. There have been studies comparing laparoscopic ventral hernia repair to open

ventral hernia repair, but the number of epigastric hernia cases were very small [33,34]. These studies focus on all types of ventral wall hernia (i.e., umbilical, epigastric, incisional, parastomal). Another study concerning solely epigastric hernia focus on mesh vs. suture repair and does not elaborate on LEHR or OEHR [8].

In this single-centre retrospective study on primary epigastric hernia, a significant difference in recurrence rates could not be demonstrated. It is noticeably however, that the recurrence rate differed 5% between groups. There are some studies that favour laparoscopic ventral hernia repair with mesh-reinforcement opposed to open ventral hernia repair in terms of recurrence rate [35-37]. However, there are no clear results from systematic reviews that argue that laparoscopic ventral hernia repair should be the gold standard in case of ventral wall hernia for the prevention of recurrences [15,16,38].

**Table 2:** Perioperative outcomes after laparoscopic and open repair.

	OEHR (n=57)	LEHR (n=42)	P-value	Missing n°
<b>Anaesthesia</b>			0.386	
General	39 (68)	26 (62)		
General + TAP block	18 (32)	16 (38)		
<b>Operation time (min)</b>	38 (17.0)	57 (16.4)	<0.001	
<b>Mean defect size (cm)</b>	2.3 (1.5)	2.0 (1.3)	0.4	37
<b>Mesh type class* used</b>				
Sepramesh 3	5 (8.8)	26 (61.9)		
Marlex 2a	42 (73.3)	0		
Composix 3	1 (1.8)	2 (4.8)		
Ventralight 3	1 (1.8)	14 (33.3)		
Parietex 3	5 (8.8)	0		
Prolene 2a	2 (3.5)	0		
Premilene 2a	1 (1.8)	0		

TAP: Transverse Abdominal Plane. Continuous variables are presented a mean and SD. Discrete variable are presented as absolute number and (percentage). P-value for categorical data was calculated with Chi-square tests, continues data with an independent t-test\*: classification system used as described by Klinge et al. [55].

**Table 3:** Postoperative outcomes after laparoscopic and open epigastric hernia repair.

Postoperative outcomes	OEHR (n=57)	LEHR (n=42)	P-value	Missing n°
<b>Mean follow-up at outpatient clinic (months)</b>	8.1 (1.9)	7.1 (6.5)	0.281	
<b>Mean follow-up by telephone (months)</b>	67.8 (20.5)	58.1 (22.3)	0.03	
<b>Recurrence</b>	4 (7.4)	1 (2.3)	0.298	
<b>VAS score &lt;24h</b>	1.73	1.47	0.432	5
<b>Hospitalization time (days)</b>	0.7 (0.3)	2.0 (2.4)	0.01	
<b>Complications</b>	3	7	0.171	
<b>Type I</b>	2 (3.7)	4 (9.5)		
Additional analgesia	2	3		
Seroma	-	1		
<b>Type II</b>	1 (1.8)	3 (7.1)		
Wound infection requiring antibiotics	1	1		
Pneumonia requiring antibiotics	-	1		
Acute kidney failure	-	1		

Complications according to the Clavien-Dindo Classification [32]. Discrete variables are presented as absolute number and (percentage). P-value for categorical data is calculated with Chi-square test.

**Table 4:** Questionnaire results in epigastric hernia patients after surgical repair.

Questionnaires	OEHR (n=57)	LEHR (n=42)	ADP*	P-value
<b>Follow-up (months)</b>	65	55		0.03
<b>SF-36</b>				
PCS	52.2	50.2	50	0.55
MCS	55.8	52.2	50	0.2
<b>CCS</b>				
Symptomatic	7 (22)	5 (24)		0.717
Asymptomatic	26 (78)	16 (76)		

ADP: Average Dutch Population; SF-36: Short-form-36 Health Survey; CCS: Carolina Comfort Scale; PCS: Physical Component Scale; MCS: Mental Component Scale. P-value for categorical data is calculated with a Chi-square test, continuous data is calculated with independent t-test. Follow-up is depicted in means.



Postoperative scores on the SF-36 Health Survey found that the perceived health in terms of Mental Component Scale (MCS) and Physical Component Scale (PCS) after both operations was higher than the average Dutch population. The average MCS and PCS of the Dutch population was 50.0. The LEHR group scored slightly lower than the OEHR group in terms of MCS (52.2 vs. 55.8,  $p=0.20$ ) and PCS (50.2 vs. 52.2,  $p=0.55$ ) (Table 4).

## Discussion

In most studies, all the different ventral wall hernia types are pooled, and little evidence is known about the management of solely primary epigastric hernias [9]. To date, there are no randomized control trials or comparative studies that compare the outcomes of laparoscopic and open primary epigastric hernia repair. There have been studies comparing laparoscopic ventral hernia repair to open ventral hernia repair, but the number of epigastric hernia cases were very small [33,34]. These studies focus on all types of ventral wall hernia (i.e., umbilical, epigastric, incisional, parastomal). Another study concerning solely epigastric hernia focus on mesh vs. suture repair and does not elaborate on LEHR or OEHR [8].

In this single-centre retrospective study on primary epigastric hernia, a significant difference in recurrence rates could not be demonstrated. It is noticeably however, that the recurrence rate differed 5% between groups. There are some studies that favour laparoscopic ventral hernia repair with mesh-reinforcement opposed to open ventral hernia repair in terms of recurrence rate [35-37]. However, there are no clear results from systematic reviews that argue that laparoscopic ventral hernia repair should be the gold standard in case of ventral wall hernia for the prevention of recurrences [15,16,38].

Other studies reported recurrence rates after laparoscopic ventral hernia repair from 1% up to 17%, with a mean rate of 4.5% [39]. This study found a rather low incidence of recurrences in LEHR group, but did not differ significantly from the OEHR group. Arguably, hernia recurrences were diagnosed by the attending physician and only if the patient reached out to the outpatient clinic. This could underestimate the incidence of hernia recurrence.

Although it can occur in both procedures, an enterotomy is a devastating complication that can occur during the introduction of the laparoscopic instruments. The incidence of these enterotomies during laparoscopic ventral and incisional hernia repair is reported to be 1.78% [40]. No enterotomies occurred in this study. A technical advantage of the laparoscopic approach is that multiple defects can be spotted during the procedure. These minimal defects, known as 'Swiss cheese' defects will not be easily visible during open repair [35].

The significant difference in gender within the LEHR group is not uncommon within ventral hernia studies [33,34,41]. This difference has been reported to be the result of women having pregnancies, and therefore are more prone to develop ventral wall hernia [42-44]. However, this has been disputed by several studies due to women having less pregnancies nowadays. [1,8,45]. In this study, the factor of cosmetic outcome could also contribute to the difference in gender in the LEHR group. The surgeon discussed this factor during intake as a part of the shared-decision making process.

With respect to the complications, it should be noted that most complications occurred in the first few years when the laparoscopic approach was introduced in both hospitals. Complications were mild, mostly resorting to postoperative pain that needed additional analgesia. Other studies report a wound infection rate after

laparoscopic ventral hernia repair from 0% to 4% [39,46]. In this study, one patient (2% and 3%) in the LEHR group reported a wound infection that needed antibiotic treatment.

Incidence rates of postoperative pain of up to 26% has been reported after laparoscopic ventral hernia repair [39]. With the use of TAP blocks, a significant reduction of postoperative opioid use and pain was found in a laparoscopic ventral hernia repair study concerning postoperative pain [28]. In this study, TAP blocks were used after 2015 which could explain the reduction in hospitalization time. The mean VAS-scores within 24 hours after surgery did not differ significantly in this study. However, the VAS-scores were lower in the LEHR group compared to the OEHR group. Other studies also report a benefit in postoperative pain after pooled laparoscopic ventral hernia repair compared to open ventral hernia repair [35,47].

The decrease in hospitalization time in this study could be explained by better postoperative pain management. While achieving more experience with the procedure, postoperative analgesia was optimized and patients were discharged sooner. This learning curve in newly implemented care PathScan be seen in another study as well [30]. The peak hospitalization time in 2015 was due to the fact that one patient developed postoperative pneumonia, and was hospitalized for 15 days. Other studies found a mean hospitalization time of 1-2 days after laparoscopic ventral hernia repair [34,48-51]. In this study, the mean hospitalization time was decreasing each year well below the mean days seen in most studies.

The SF-36 and CCS have been used in pooled laparoscopic ventral hernia repair compared to pooled open ventral hernia repair before, and was in favour of the laparoscopic ventral hernia repair group [52]. The difference in the SF-36 questionnaire results in this study could be due to the fact that only two dedicated surgeons performed the laparoscopic procedure, indicating that patients who received this procedure had a preoperative poorer status or hernia configuration, thus complicating the postoperative course. Additionally, the follow-up duration by telephone of patients with OEHR was significantly longer (67.8 months vs. 58.1 months,  $p=0.03$ ), which would mean that this group had a longer time to recover from their operation before answering the questionnaire. However, in comparison to the average Dutch population, both the scores of the LEHR and OEHR groups were higher, indicating that the postoperative perceived health of both groups was high.

Mayo's technique [53] for ventral hernia repair has been carried out since 1901, while LEHR has only been used since the first laparoscopic ventral hernia repair in 1991 by Leblanc et al. [54]. This difference in time both techniques have been used, could implicate that LEHR is still in a developmental stage. In this study, the development around the care path for epigastric hernias was optimized by the use of TAP-blocks. Another explanation for better postoperative outcomes in the last years of this study might be explained by the surgeons achieving more experience with the laparoscopic technique, thus having more confidence to discharge patients sooner. This may have contributed in the lower hospitalization time, and the fewer complications seen in the last year the procedure was used [55]. To optimise the treatment of epigastric hernias, prospective studies with radiological follow-up are of paramount importance.

## Limitations

This cohort study has some limitations. First, the retrospective study design prevented to assess certain pre-and postoperative patient

characteristics. It should be noted that hernia defect size was not always recorded, and postoperative follow-up was short, usually one month. On the other hand, patients were instructed to return to the hospital in case of complaints. However, this may have underestimated the recurrence rate in both groups, since recurrent hernias are not always symptomatic in the first years. The meshes used in this study differ between the operation groups. The surgeons who performed the laparoscopic approach preferred specific types of meshes, while the surgeons who preferred the conventional approach did not use specialized meshes. Aesthetic complaints were not addressed in this study. One could imagine that the cosmetic outcome of an epigastric hernia is better with a laparoscopic approach compared to a midline subxiphoidal incision, though this has not been investigated in other studies.

## Conclusion

The laparoscopic epigastric hernia repair had a slightly lower recurrence percentage compared to the open epigastric hernia repair, although this did not reach statistical significance. Postoperative outcomes were comparable and hospitalization time was declining. Therefore, laparoscopic epigastric hernia repair is a good and feasible alternative to conventional open repair. Prospective studies focusing on solely epigastric hernias with radiological follow-up are needed to validate the results found in this study.

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