Risk factors for recurrence after laparoscopic inguinal hernia repair: a 5-year retrospective cohort study

Factores de riesgo de recidiva luego de la hernioplastia inguinal laparoscópica: seguimiento de una cohorte a 5 años

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ABSTRACT

Background: The benefits of laparoscopic inguinal hernia repair are multiple; however, the recurrence rate is still controversial and under debate.
Objective: The aim of this study is to analyze the risk factors associated with long-term recurrence after laparoscopic inguinal hernia repair.
Methods: The cohort was made up of consecutive patients undergoing transabdominal preperitoneal approach between December 2012 and May 2017, with a minimum follow-up of 6 months. The sample was divided into two groups: G1 (patients with recurrence) and G2 (patients without recurrence). The demographic and clinical variables and the outcomes at 5 years were analyzed.
Results: A total of 717 inguinal hernia repairs were performed in 443 patients. Smoking habits, previous recurrence, mesh size < 12 ×15 cm and surgeries carried out by surgical teams performing < 30 procedures per year were significantly associated with recurrence on univariate analysis (p < 0.05). However, only smoking habits and surgeries performed by less experienced surgeons showed statistical significance on multivariate analysis (p < 0.01). Recurrence rate was 1.5% at 2 years and increased to 2.6% (n = 19) at 5 years.
Conclusion: Extending the follow-up period beyond 2 years after laparoscopic inguinal hernia repair allows a more accurate detection of the recurrence rate. In this series, smoking habits and surgeries performed by less experienced surgeons were significantly associated with recurrences.

Keywords: inguinal hernia, TAPP, laparoscopic, recurrence, risk factors.

RESUMEN

Antecedentes: la hernioplastia inguinal laparoscópica ha demostrado múltiples beneficios. Sin embargo, la tasa de recidiva continúa siendo materia de estudio y controversia.
Objetivo: analizar factores de riesgo de recidiva poshernioplastia inguinal laparoscópica con seguimiento posoperatorio alejado.
Resultados: se realizaron 717 hernioplastias en 443 pacientes. El tabaquismo, una recidiva previa, la malla menor de 12 ×15 cm y cirugías realizadas por equipos con menos de 30 plásticas/año se relacionaron en forma significativa con recidiva en el análisis univariado (p < 0,05). Sin embargo, el tabaquismo y los pacientes operados por equipos de menor experiencia mostraron significancia estadística en el análisis multivariado (p < 0,01). Con un seguimiento de 2 años se detectó una tasa de recidiva de 1,5%, mientras que esa cifra ascendió a 2,6% (n = 19) a los 5 años.
Conclusión: prolongar el tiempo de seguimiento más allá de los 2 años luego de la plástica inguinal laparoscópica permite una detección más precisa de la tasa de recidiva. En la presente serie, el tabaquismo y un equipo tratante de menor experiencia fueron factores que impactan de forma significativa en su desarrollo.

Palabras clave: hernia inguinal, TAPP, laparoscopía, recidiva, factores de riesgo.
Introduction

Inguinal hernia repair is one of the most common procedures in general surgery. Laparoscopic approach has gained popularity since it was introduced in the early 90’s, becoming a standard treatment in high-volume centers. The benefits of the procedure include reduction in postoperative (POP) pain, early recovery, rapid return to working activities and better quality of life. The most commonly used minimally invasive techniques for inguinal hernia repair are the transabdominal preperitoneal (TAPP) approach and the totally extraperitoneal (TEP) approach. However, the standard has not been established yet, and the method is chosen at the discretion of the surgeon.

Despite laparoscopic surgery is widely used, the technique is still under debate in regard with the rate of complications compared to conventional surgery. Several aspects are taken into account when choosing the appropriate approach: patient-related factors, learning curve and type of defect. The advent of new technologies and the greater training in laparoscopic techniques facilitated their broad use in most centers by surgeons specialized in the treatment of abdominal wall defects, establishing recurrence rates that are similar to those of conventional surgery. In this way, the international guidelines recommend the minimally invasive approach as first-line treatment. The evaluation of the long-term POP outcomes is needed for a more comprehensive analysis of the durability of inguinal hernia repair. This would provide an opportunity to assess the implication of risk factors for recurrence which are not apparent in the short term, along with a more accurate detection of the recurrence rate.

Several publications have attempted to identify the risk factors associated with complications after laparoscopic inguinal hernia repair (LIHR). However, as POP follow-up time is very heterogeneous among the series, it is difficult to establish a minimum follow-up period to determine if LIHR meets the desired standards. Based on these considerations, we decided to carry out this study with the aim of analyzing the risk factors for recurrence after LIHR with a long-term analysis.

Methods

The clinical records of patients undergoing scheduled inguinal hernia repair between December 2012 and May 2017 were retrospectively reviewed. Only LIHR via the TAPP approach followed-up for at least 6 months were included in the analysis.

The procedures were performed on a day care basis except for those patients who had to be hospitalized in the general ward due to late operations, comorbidities or social issues.

Surgical technique

All the procedures were performed under general anesthesia. A 10-mm trocar in the umbilical region was placed in the umbilical region and two 5-mm trocars were inserted in both lumbar regions. Pneumoperitoneum was set at a pressure of 10-12 mm Hg. An incision was made in the peritoneum at the umbilical ligament and was then extended in an oblique direction toward the anterior superior iliac spine. An inferior peritoneal flap was created to access the preperitoneal space. The hernia was reduced and the inferior epigastric vessels and contents of the spermatic cord or round ligament were identified. In all the cases, a mesh was place to reinforce the repair and was fixed to the Cooper ligament, arch of the transversus abdominis and rectus abdominis with absorbable tacks. The type and size of the mesh were left to the discretion of the surgeon. Once the mesh was fixed, the peritoneum was closed with continuous absorbable suture. Finally, all ports were removed under direct vision and pneumoperitoneum was evacuated. The associated inguinal or ventral defects found during surgery were repaired in all the cases.

Sample analysis

The sample was divided into two groups: group 1 (G1) included patients with recurrent hernia during POP follow-up and group 2 (G2) without recurrent hernia.

Demographic, intraoperative and postoperative factors were analyzed. Postoperative follow-up was performed at 10 days, 1 month, 6 months, 1 year, and then once a year.

Statistical analysis

Data were stored using a Microsoft Office Excel® spreadsheet. Continuous variables were compared using the chi square test and the Student’s t test was used to compare categorical variables, as applicable. A multivariate logistic regression analysis was performed using SPSS 24.0 statistical package. A p value < 0.05 was considered statistically significant.

Results

A total of 717 LIHR via the TAPP approach were performed in 443 patients. Mean follow-up was 30 months (range: 6 to 62 months). During this period,
19 (2.6%) recurrences occurred, constituting G1. In the remaining surgeries (G2, n = 698) no recurrences were detected.

The demographic variables are shown in Table 1. Mean age was 55 years in G1 and 58 years in G2, and 90% were men in both groups. Mean body mass index (BMI) was similar in both groups (G1: 25.9 kg/m² vs. G2: 26.3 kg/m²). The difference remained non significant after stratification of obesity severity according to the BMI. The ASA physical status classification system was grade 2 in all G1 patients and in 98% of G2 patients. Smoking habits were significantly more common in G1 compared to G2 [40% vs. 18% OR: 4.1 (1.5-11.5), p = 0.01]. There was a significantly greater proportion of patients undergoing surgery due to recurrent hernia in G1 versus G2 [12%; OR: 3.5 (1.2-10.3)]. However, on multivariate analysis, only smoking habits showed statistical significance.

Among intraoperative variables (Table 2), surgery duration was similar in both groups (G1: 105 min vs. G2: 117 min). Mean hernia size was greater in the group with recurrence, but this difference was not significant (G1: 4.3 cm vs. G2: 3.9 cm), even when the classification of the European Hernia Society was used. The proportion of direct hernias was more common in G1 (68% vs. 48%) but this difference was not significant. Mesh sizes were smaller in the group with recurrent hernia (G1: 146 cm² vs. G2: 162 cm²). After stratification, a significant difference was observed in those cases in which the size of the mesh used was < 12 x15 cm [G1: 84% vs. G2: 58%, OR: 3.9 (1.1-17.2), p < 0.05]. Yet, this could not be confirmed on multivariate analysis. Most hernia repairs were performed with heavy-weight polypropylene meshes (85%), but no significant differences were found with repairs using light-weight meshes. When we examined the influence of the surgical team experience on the success of the procedure, we observed that surgeons performing < 30 LIHR per year carried out 37% surgeries in G1 but only 11% in G2, and this difference was statistically significant [OR: 3.9 (1.3-11.2), p < 0.01]. This association was confirmed on multivariate analysis (Table 3).

As we have previously mentioned, the global recurrence rate was 2.6%, with a total of 19 inguinal hernia repair procedures over the 5-year follow-up period: 6 at 6 months, 4 after 1 year, 1 at 2 years, 4 at 3 years, 1 at 4 years and 3 after 5 years (Fig. 1). In this way, 11 recurrences (1.5%) occurred 2 years after surgery, constituting 58% of all the recurrences.

**Discussion**

Since its introduction, LIHR has progressed through different stages and is nowadays the first-line strategy in referral centers. Despite the benefits obtained with the minimally invasive approach, the recurrence rate is under continuous evaluation as it

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**TABLE 1**

Demographic variables

<table>
<thead>
<tr>
<th></th>
<th>G1 (n=19)</th>
<th>G2 (n=698)</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>55 (27-82)</td>
<td>58 (20-91)</td>
<td>NS</td>
</tr>
<tr>
<td>Sex (M:F)</td>
<td>17:02</td>
<td>384:40</td>
<td>NS</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.9 +/- 3.4</td>
<td>26.3 +/- 3.4</td>
<td>NS</td>
</tr>
<tr>
<td>BMI &gt; 25</td>
<td>8</td>
<td>173</td>
<td>NS</td>
</tr>
<tr>
<td>ASA grade 1-2 (%)</td>
<td>100</td>
<td>98</td>
<td>NS</td>
</tr>
<tr>
<td>SH (%)</td>
<td>8 (40)</td>
<td>74 (18)</td>
<td>0.01</td>
</tr>
<tr>
<td>Recurrent hernia (%)</td>
<td>6 (31)</td>
<td>82 (12)</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Demographic variables. Smoking habits and prior recurrence were more common in the group of patients with recurrent hernia. There were no significant differences in age, sex, BMI or ASA physical status classification system. G1: with recurrent hernia. G2: without recurrent hernia. BMI: Body mass index. SH: Smoking habits ASA: American Society of Anesthesiology.

**TABLE 2**

Intraoperative variables

<table>
<thead>
<tr>
<th></th>
<th>G1 (n=19)</th>
<th>G2 (n=698)</th>
<th>p</th>
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<tbody>
<tr>
<td>Surgery duration (min)</td>
<td>105</td>
<td>117</td>
<td>NS</td>
</tr>
<tr>
<td>Defect characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defect size (cm)</td>
<td>4.3 (2-8)</td>
<td>3.9 (2-10)</td>
<td>NS</td>
</tr>
<tr>
<td>Defect size &gt; 4 cm</td>
<td>11</td>
<td>351</td>
<td>NS</td>
</tr>
<tr>
<td>Direct hernia (%)</td>
<td>13 (68)</td>
<td>337 (48)</td>
<td>NS</td>
</tr>
<tr>
<td>Indirect hernia (%)</td>
<td>6 (32)</td>
<td>361 (52)</td>
<td>NS</td>
</tr>
<tr>
<td>Mesh</td>
<td>146</td>
<td>162</td>
<td>NS</td>
</tr>
<tr>
<td>Size (cm²)</td>
<td>16</td>
<td>176</td>
<td>0.03</td>
</tr>
<tr>
<td>Light-weight mesh</td>
<td>8 (44)</td>
<td>155 (38)</td>
<td>NS</td>
</tr>
<tr>
<td>Team</td>
<td>&gt; 30 LIHR/year (%)</td>
<td>12 (63)</td>
<td>622 (89)</td>
</tr>
<tr>
<td>&lt; 30 LIHR/year (%)</td>
<td>7 (37)</td>
<td>76 (11)</td>
<td></td>
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</table>

Intraoperative variables. Mesh size < 12 x15 cm and surgeries carried out by surgical teams performing < 30 procedures per year were significantly associated with recurrences. There were no differences regarding surgery duration, size of the defect, presence of lateral hernias or mesh material. G1: with recurrent hernia. G2: without recurrent hernia.
is considered failure of the procedure. In this way, recurrence rate could be considered as a long-term quality control, together with quality of life and chronic pain. Long-term follow-up would be the most adequate tool to evaluate recurrence rate, as the different published series have heterogeneous POP follow-up periods.

In our series, global recurrence rate was 2.6% (19/717) after a mean follow-up of 30 (6-62) months. Similar results were observed in other series that had established an association between the follow-up period and the recurrence rate after LIHR. Direct (medial) hernias undergoing laparoscopic repair present higher recurrence rate than indirect (lateral) hernias. This could be due to the fact that in large defects (> 4 cm) the abdominal wall is weaker and the mesh prosthesis does not provide sufficient support, predisposing to future recurrence. In this case, the medial compartment should be properly dissected until the pubic symphysis is identified, achieving adequate overlapping of the mesh prosthesis.

In our cohort, extending the follow-up period to 5 years resulted in almost a two-fold increase in the number of cases, which leads us to understand recurrence as a process in which multiple risk factors are interrelated over time.

Several factors, as BMI, smoking habits, size of the defect, type of hernia (direct or indirect) and previous recurrence have been associated with recurrence after mesh repair of inguinal hernia.

In our series, BMI was not significantly different in the group with recurrence and without recurrence, probably because BMI was almost normal in both groups.

Recurrence was more common among smokers, with significant differences on multivariate analysis. These findings are consistent with those of other series and emphasize the deleterious effect of smoking habits on microcirculation (angiogenesis), a vital factor in the healing process and integration of the prosthesis.

In our cohort, we did not observe significant differences between direct and indirect hernias or small and large defects. These observations are opposed to those reported in the literature, where larger hernias as M3 and L3 of the classification of the European Hernia Society have been associated with greater recurrence rate. Direct (medial) hernias undergoing laparoscopic repair present higher recurrence rate than indirect (lateral) hernias. This could be due to the fact that in large defects (> 4 cm) the abdominal wall is weaker and the mesh prosthesis does not provide sufficient support, predisposing to future recurrence. In this case, the medial compartment should be properly dissected until the pubic symphysis is identified, achieving adequate overlapping of the mesh prosthesis.

The mesh size seems to influence the recurrence rate, as a small mesh requires a small dissection, can shrink and migrate. In our case, we observed that patients with mesh measuring > 12 × 15 cm presented higher recurrence rate that was not statistical significant on multivariate analysis (p = 0.3).

A history of a previous recurrence predisposes to future higher failure rate, probably because previous scars and prosthetic materials might interfere with the integration of the new prosthesis. Our results showed a trend (p = 0.09) toward higher incidence of recurrence in patients undergoing surgery for recurrent inguinal hernia.

Finally, the experience of the surgical team had a significant influence on the recurrence rate. In our series, surgeons with different levels of experience tutoring in-training physicians seem to influence on the outcomes. Surgeons performing < 30 surgeries per year had a strong association with higher recurrence rate that was confirmed by multivariate analysis (p < 0.01). These results emphasize the need to standardize training and to make an appropriate

### TABLE 3

<table>
<thead>
<tr>
<th></th>
<th>G1</th>
<th>G2</th>
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<tbody>
<tr>
<td>SH (%)</td>
<td>8 (40)</td>
<td>74 (18)</td>
<td>0.01</td>
</tr>
<tr>
<td>Mesh &lt; 12×15 (%)</td>
<td>16 (84)</td>
<td>176 (58)</td>
<td>0.3</td>
</tr>
<tr>
<td>Previous recurrence</td>
<td>6 (31)</td>
<td>82 (12)</td>
<td>0.09</td>
</tr>
<tr>
<td>Surgical team &lt; 30 LIHR/year (%)</td>
<td>7 (37)</td>
<td>76 (11)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Multivariate analysis Smoking habits and surgeries carried out by surgical teams performing < 30 procedures per year were significantly associated with recurrences. G1: with recurrent hernia. G2: without recurrent hernia. SH: Smoking habits.
selection of cases to be dealt with by in-training physicians. The influence of the learning curves in different types of surgery has been analyzed in other studies, showing better outcomes with experienced teams\textsuperscript{3,11,12,14}. This remains a subject of debate, as the results differ from those of other studies\textsuperscript{8,10}, suggesting that better results could be achieved with low threshold for conversion, low threshold to ask for an intraoperative second opinion, and selecting the most difficult cases for experienced surgeons.

Our study has some limitations: firstly, its retrospective nature. Secondly, the small number of patients with recurrence may be a limitation to reach statistical significance to detect any unobserved risk factor. However, the fact that more than 70% of the patients were followed-up for 2 years or greater reinforces the strategy proposed. This would allow a better understanding of the disease, giving rise to new questions and, in consequence, to new work in an effort to understand the process of recurrence of inguinal hernia. In addition, there are scarce publications in our country evaluating long-term outcomes. Therefore, we consider that is study provides relevant information.

Conclusions

After LIHR via TAPP approach, patients with smoking habits and those in whom the procedure was carried out by a team performing <30 surgeries per year presented significantly greater recurrence rate. Long-term follow-up seems to influence the rate of detection. Less than 60% of the cases are identified at 2 years of follow-up with a two-fold increase after 60 months. This finding suggests the need to establish a longer follow-up period to reduce bias and heterogeneity for assessing long-term complications.

References