



SURGERY

Influence of the learning curve on the immediate postoperative pain intensity after laparoscopic inguinal hernioplasty

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Abstract

Introduction. Inguinal hernia repairs represent one of the most commonly performed surgical operations worldwide. As more experience has been gained over the past decades with laparoscopic techniques, they are now widely used also for the repair of primary and unilateral inguinal hernias, representing a safe and effective alternative. One of the major concerns of patients undergoing inguinal hernia repair is postoperative pain and socio-professional reintegration.

Aim of study. This study started from the hypothesis that the learning curve could influence postoperative pain intensity after laparoscopic inguinal hernioplasty.

Methods. A retrospective - comparative study was performed, including a general surgeon's first consecutive cases (n=87) of TAPP (transabdominal preperitoneal procedure) hernioplasty procedures with implantation of self-gripping surgical prosthesis were investigated.

Results. The evaluation of clinical and surgical aspects resulted in similar values in case of the studied groups. A reduction in surgical time was observed in case of patients operated after completing the learning curve ($p = 0.0005$) On the first postoperative day patients complained mostly about persistent and severe type of pain. Average Pain Index calculated with help of Simple Numeric Pain Scale resulted in similar values. Length of analgesic treatment showed no significant differences. Although higher intensity pain was mostly characteristic in case of patients operated during the learning process, no significant relationship between learning curve and postoperative pain intensity were highlighted.

Conclusion. TAPP can be a safe technique for young surgeons as well, with the right study program the procedure can be mastered safely.

Keywords: inguinal hernia, TAPP procedure, self-gripping surgical mesh, postoperative pain

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Introduction and aim

Inguinal hernia repairs are one of the most commonly performed surgical interventions worldwide. These type of parietal defects account around 75% of all abdominal wall hernias, for which surgical repair represents the definitive treatment [1]. In order to ensure defect closure and a tension-free repair both open and laparoscopic approach can be used safely [2]. In the beginning, primary indication for laparoscopic approach has been set

for bilateral and recurrent inguinal hernias. As more experience has been gained over the past decades with laparoscopic techniques, it is now widely used for the repair of primary and unilateral inguinal hernias as well, representing a safe and effective alternative, with postoperative complication rates comparable with open repair. However, transabdominal preperitoneal procedure (TAPP) still represent a technique feared by many surgeons, probably due to its steep learning

curve and possible severe intraoperative complications [3]. One of the major patient concerns undergoing inguinal hernia repair is postoperative pain, which represents an unwanted and feared complication, which can lead to functional limitations and life quality changes [4,5].

The present research started from the hypothesis that the learning curve could influence postoperative pain intensity after laparoscopic inguinal hernioplasty.

Methods

Inclusion criteria

Patients over 18 years old, diagnosed with inguinal hernia who were scheduled for elective hernioplasty were enrolled in the present research. Exclusion criteria were the following: other laparoscopic treatment options than TAPP procedure; utilization of other types of prosthesis than self-gripping surgical mesh; open surgical techniques; patients who presented any kind of chronic pain or complained about pain sensation in the inguinal region at the time of hospital admission.

Definitions

Learning curve is defined as the number of surgical interventions that result in a certain surgical technique being safely performed and controlled. Regarding this aspect, different opinions can be found in literature, but the learning curve of laparoscopic transabdominal preperitoneal (TAPP) surgery is generally estimated at about 30 cases at least [6].

Postoperative pain represents pain sensation at the surgical site, which was not present before surgical intervention and other causes of pain are excluded. During the present research we differentiated *immediate postoperative pain* as post-surgical pain sensation perceived during hospitalization.

Patient selection and establishment of study groups

We conducted a retrospective - comparative study, during which a general surgeon's first 87 consecutive cases of TAPP hernioplasty procedures with implantation of self-gripping surgical prosthesis were investigated. Data were gathered from medical charts and operative protocols, while patients were divided into two groups as follows: Study Group – including the first 30 patients operated (defined as the period of learning curve); Control Group – containing the following 57 patients operated (after completing the training period).

Data collection

Assessment of clinical and surgical aspects included the following data: gender, age, occurrence, side and type of

parietal defect. In order to ease interpretation of the above mentioned aspects, different subcategories were created. The age subgroups were: *young adults* (between 18-39 years old), *middle aged adults* (between 40-60 years old) and *elderly* (over 60 years old). Length of surgical intervention was also investigated, during which we differentiated: *short operations* (<60 minutes), *intermediate operations* (between 60-90 minutes) and *long operations* (>90 minutes). Complications occurring throughout surgical intervention were noted and analyzed as well. From a postoperative point of view, presence-, nature-, intensity of postoperative pain, presence of complications and length of hospitalization were evaluated. In order to estimate pain intensity, numeric pain scale completed by patients on the 1st postoperative day was interpreted. Simple Numeric Pain Intensity Scale uses numerical rating to describe pain intensity as follows: No pain (0); Mild pain (1-3); Moderate pain (4-6); Severe pain (7-9); Worst pain ever (10) (Figure 1).

During the analysis of postoperative pain nature, *persistent*, *intermittent* and *irradiating* subcategories were separated. In order to highlight the possible influence of the learning curve on postoperative pain intensity, we classified pain (according to the Simple Numeric Pain Intensity Scale) as *Higher Intensity Postoperative Pain* (containing patients with Severe and Worst pain) and *Lower Intensity Postoperative Pain* (containing patients with Mild and Moderate pain). These data were then correlated with the period of surgical intervention, whether the operation was performed during learning curve or after completing the training period.

Statistical analysis

Data were processed using Microsoft Excel. The statistical analysis of the database was performed using GraphPad InStat software (GraphPad Software, Inc., San Diego, United States of America). Quantitative variables are presented by mean and median, while qualitative and categorical variables are expressed both as integer and percentage values. A normality test was applied for all variable groups in order to determine the distribution of values. Furthermore, for the quantitative statistical analysis Student's t-test was applied for groups with Gaussian distribution of values, while Mann-Whitney nonparametric test was used for groups with non-Gaussian distribution. Inferential statistical analysis involving odds ratios determination for influence of learning curve on postoperative pain intensity was performed using Fisher's Exact Test. The level of statistical significance for the present research was set at a p value of 0.05, while the confidence interval was 95% for all the calculated parameters.

0	1	2	3	4	5	6	7	8	9	10
No pain	Mild pain			Moderate pain			Severe pain		Worst pain	

Figure 1. Simple Numeric Pain Intensity Scale.

Results

Evaluation of results gained during learning curve

During the learning period, male (93.33%, n=28) and middle aged patients (53.33%, n=16) were present in a higher proportion. Average age for this group of patients was found to be 49.63 years. Parietal defects were exclusively primary with domination of left side (56.66%, n=17) and external oblique (70%, n=21) hernias. Regarding the duration of surgical intervention, mostly intermediate type operations (60-90 minutes) were identified (76.66%, n=23, $P=0.0002$) (Table I). During surgical interventions two intraabdominal bleedings were registered, for which electrocoagulation and hemostatic clips were applied with success. During hospitalization all patients complained about pain sensation at the surgical site. Mostly their pain was described as persistent (56.67%, n=17), followed by intermittent (36.67%, n=11) and irradiating (6.66%, n=2) subtypes. The average postoperative Pain Index resulted to be 6.86. During hospitalization no complications were registered. Length of analgesic treatment was an average period of 2.10 days (Figures 2, 3).

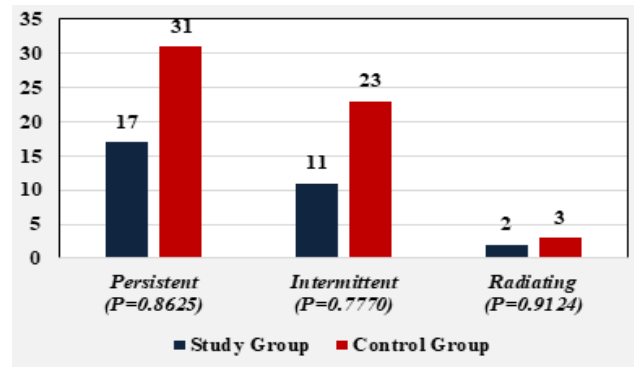


Figure 2. Nature of postoperative pain.

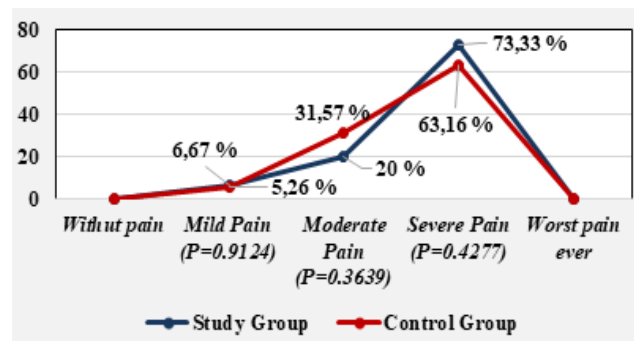


Figure 3. Distribution of pain intensity among patients.

Table I. Clinical and surgical aspects.

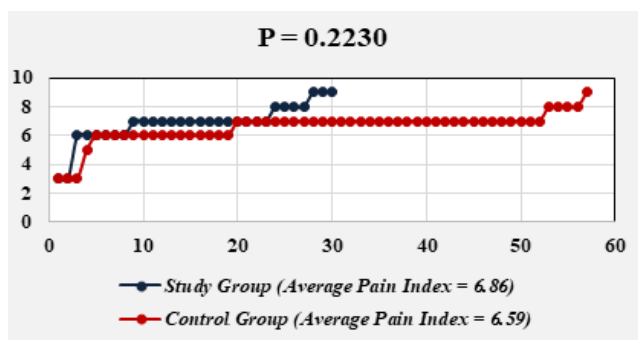
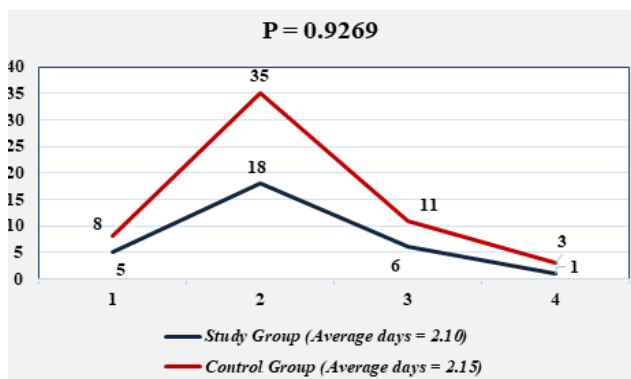
	Study Group N=30	Control Group N=57	P value
Gender			
Male	28 (93.33)	51 (89.47)	0.7577
Female	2 (6.67)	6 (10.53)	0.7577
Age			
Average	49.63	50.31	-
Young adults	6 (20)	15 (26.32)	0.6204
Middle aged adults	16 (53.33)	26 (45.61)	0.5507
Elderly adults	8 (26.67)	16 (28.07)	0.9155
Hernia occurrence			
Primary	30 (100)	52 (91.23)	-
Recurrent	0 (0)	5 (8.77)	-
Side of parietal defect			
Right	11 (36.67)	20 (35.09)	0.7042
Left	17 (56.66)	19 (33.33)	0.0697
Bilateral	2 (6.67)	18 (31.58)	0.0493
Type of hernia			
Direct	7 (23.33)	11 (19.30)	0.7518
External oblique	21 (70)	36 (63.16)	0.5951
Mixt	2 (6.67)	10 (17.54)	0.3844
Length of surgery			
Average			-
Short	5 (16.67)	35 (61.40)	0.0005
Intermediate	23 (76.66)	16 (28.07)	0.0002
Long	2 (6.67)	6 (10.53)	0.7577
Complications			
Intraoperative	2 (6.67)	0 (0)	-

Table II. Influence of learning curve on postoperative pain intensity.

	Higher intensity postoperative pain	Lower intensity postoperative pain	P value	OR	RR
During learning curve	22 (73.33)	8 (26.67)	0.4734	1.604	1.161
After learning curve	36 (63.16)	21 (36.84)	0.4734	0.623	0.8612

Evaluation of results gained after completing learning curve

Predominantly male (89.47%, n=51) and middle aged (45.61%, n=26) patients were present, with an average age of 50.31 years old. Primary (91.23%, n=52), right sided (35.09%, n=20) and external oblique (63.16%, n=36) hernias were present in a higher proportion. During this period significantly shorter operations were recorded (61.40%, n=35, P=0.0005) and no intraoperative complications were registered. In the postoperative period, likewise, every patient accused pain sensation of different intensity at the surgical site. Mostly persistent subtypes were reported (54.39%, n=31), with an average postoperative Pain Index of 6.59. During hospitalization a single case of trocar hematoma was highlighted, for which evacuation was performed with success. Length of analgesic treatment was necessary for an average period of 2.15 days (Figures 4, 5).

**Figure 4.** Postoperative pain index and average value.**Figure 5.** Length of postoperative analgesic treatment.

Learning curve and postoperative pain intensity

Analyzing immediate postoperative pain intensity in different stages of the surgeon's professional evolution, we found higher intensity pain in a proportion of 73.33% (n=22/30) for patients operated during learning curve and 63.16% (n=36/57) in case of those treated after completing the learning process (Table II). From a statistical point of view, slightly increased odds can be observed for the above mentioned relationship but without statistical significance.

Discussion

Laparoscopic hernioplasty with self-gripping mesh implantation

Currently no consensus about the ideal surgical treatment for groin hernia can be found, open procedures are widely used, while the practice of minimally invasive techniques is on the rise. More and more surgeons are opting for laparoscopic treatment, with several studies highlighting the benefits of these interventions [7]. The unusual anatomy of the posterior inguinal wall, associated with the necessity of special training and the longer learning curve make minimally invasive interventions more complex [8]. One of the main problems in the field of minimally invasive hernioplasty remain mesh fixation aspects. Several studies highlighted that traumatic fixation of the surgical mesh increases the potential for development of postoperative pain [9]. Therefore non-traumatic fixation of the prosthesis with surgical adhesive or self-gripping surgical mesh is strongly recommended [10].

Postoperative pain

Postoperative pain still represents a feared complication following inguinal hernioplasty, up to 8-16% of patients can experience this kind of unpleasant sensations and depending on the degree of pain, it can have a major impact on daily activities and socio-professional reintegration. The cause of this unwanted complication is not well elucidated either, but it is likely multifactorial with several contributing components [11]. Over the past decade, a number of risk factors that may contribute to the development of postoperative pain have been highlighted. Several studies consider female gender, young age, increased intensity of early postoperative pain, and recurrent hernia strong risk factors for this unwanted complication [12].

Type of synthetic mesh has also been a central theme for recent studies, underlining the difficulty of interpreting these data due to the variety and characteristics of surgical prostheses (weight, pore size, strength, flexibility). However, regarding mesh fixation methods there seems to be a consensus that the types of mesh requiring fixation may have a negative effect on postoperative pain levels. Therefore, according to several researchers the use of self-adhesive prosthesis result in less postoperative pain [13,14]. Not least, surgical technique also represented the theme of many articles, therefore various studies emphasize that surgical procedure and technique can also influence the development of pain-related complications and also highlighting that minimally invasive approach may result in less postoperative pain as opposed to an open surgical technique [15].

Learning curve for TAPP procedure and its outcome on postoperative pain intensity

Few specific data can be found in the literature about the effect of the learning curve on postoperative pain. The concept of the learning curve is to quantify the degree of individual adaptation and to study the real-time adaptation process of laparoscopic surgery. Regarding this aspect, there are still controversies: some researchers state that a surgeon with basic laparoscopic training initially needs about 13 to 15 cases to master the TAPP technique [16]. Other authors have been more cautious, estimating the learning curve for minimally invasive hernioplasty at 30 cases [6]. However, there is a consensus that training, learning curve, and supervision are important aspects in the outcome of hernia surgeries. A recent article has shown significant reduction in surgical time, conversion rate, and complication rates following 30-100 TEP and 50-75 TAPP procedures. Other researchers conducted a comparative study and found no significantly higher rates of postoperative complications or recurrence in patients operated by supervised trainees compared to patients operated by experienced surgeons [17,18]. Literature reviews draw attention to the association between higher surgical volume and better postoperative outcomes. A study of 125,342 patients identified a higher rate of postoperative complications in case of surgeons who underwent fewer laparoscopic hernioplasty procedures. Similarly, a laparo-endoscopic study including 16,240 patients identified significantly higher recurrence rates and higher postoperative pain values in case of surgeons who performed less than 25 laparo-endoscopic procedures per year for the treatment of primary groin hernia [19,20].

Conclusion

The surgeons' influence on the patients' postoperative evolution is proven, which in addition could influence the outcome of inguinal hernioplasty too. TAPP can be a safe technique for young surgeons as well, but for optimal treatment results, well-structured professional

training, simulation-based experience, supervision, and surgical volume are essential and necessary. Further larger studies are required to draw general conclusions.

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