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***MINIMALLY INVASIVE SURGICAL
TREATMENT OF INGUINAL HERNIAS IN AN
EMERGENCY***
SUMMARY OF THE THESIS

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Introduction

In surgical practice, one of the most commonly encountered pathology is represented by the inguinal-femoral parietal defect that has an incidence of occurrence in the general population between 3% and 8% [1], even up to 15% according to other authors [2], with approximately 20 million such surgeries performed annually worldwide [3].

Inguinal hernia is a common condition in the male sex (86% cases), while femoral hernia predominates in the female sex (84% of the total number of hernias) [1]. The risk of developing a hernia during life is 27% for men and 3% for women [4].

Of all the defects of the anterior abdominal wall, 75% are found in the inguinal region, with the following distribution of its subtypes: 50% indirect hernias (mostly external oblique), 25% direct hernias and only 5% are femoral hernias [1].

The surgical techniques used in the treatment of this condition constantly require an adaptation with the evolution and appearance of modern materials and equipment, the effectiveness of each method being intensively studied as it was introduced into medical practice.

Thus, at first, the procedures used were tissue ones, which used to strengthen the posterior wall of the inguinal canal only the anatomical structures of the patient, the best known being Bassini (1884), Shouldice (1939) and Nyhus.

The high recurrence rate, the tension in the suture and in the neighboring tissues, the regional paresthesia are some of the complications that determined the gradual reduction of these procedures, although they had certain advantages, such as: they could be performed only with local anesthesia, without additional anesthetic and surgical risks in patients with comorbidities or the elderly; low cost due to both simple surgical equipment and cheap consumables; few postoperative complications have been reported (infections, inguinal pain, ischemic orchitis). [5, 6]

Nowadays, tissue techniques are still used in several situations: in complicated hernias with septic condition or localized peritonitis; in patients with high anesthetic and surgical risk that contraindicates another type of procedure; in patients allergic to prosthetic material or those with low immunity; at the express request of the patient, although the indication is relative; due to the absence of prosthetic material from the stock of the clinic / hospital; depending on the

preference of the doctor who chooses the procedure with which he is most comfortable; in cases of contraindication to other types of surgical techniques or if spinal and general anesthesia are contraindicated (elderly patients or patients with comorbidities and significant surgical risk) [6].

In order to eliminate these inconveniences and the tension in the suture, the prosthetic material that had the role of strengthening the posterior wall of the inguinal canal was introduced into medical practice.

Initially these prostheses were made up of biological materials, then they were improved with a metal coating, and later non-metallic synthetic prostheses made up of polymers such as polypropylene, teraphthalate polyethene, polytetrafluoroethylene appeared [7].

Several types of "tension-free" procedures have been developed, with the positioning of the prosthesis in different anatomical areas, having as main purpose the decrease of the recurrence rate, but also the increase of the patient's quality of life by reducing the postoperative complications [8], but with the assumption of a risk of developing infections and with an increased cost [6].

Among the first "tension - free" techniques with open preperitoneal approach was the Stoppa – Wantz process, which, being a complicated procedure and associating the possibility of major damage to neighboring organs, is no longer used so frequently [9].

The constant need to find the optimal surgical procedure for the treatment of groin defects led to the introduction in 1984 of the "tension-free" Lichtenstein procedure, which became the "gold standard" of the treatment of this pathology [6, 10], lowering the recurrence rate from 10% to 1.3% [5].

When a mini-video camera was connected to an endoscope, making the image of an operating field identical to that in the open approach, but amplified by 5 to 15 times, the era of modern laparoscopy began. The first laparoscopic intervention was cholecystectomy performed in France in 1988, then in the United States in 1988 and in 1990 in Belgium, so in 1992 it became the "gold standard" for the treatment of cholelithiasis [11].

In the course of a year, starting with 1993, laparoscopic techniques for cholelithiasis and for the diagnosis of the painful abdomen were accepted and put into practice, subsequently these techniques were developed and adapted to achieve appendectomy, exploring the main bile duct, correcting abdominal hernias, intestinal resection, diaphragmatic hernias, peptic ulcers. For the

performance of esophageal myotomies, splenectomy, adrenalectomy, liver cysts and certain palliative digestive derivatives, the laparoscopic approach was, at that time, developing [11].

The first inguinal hernias treated by laparoscopic approach were described in 1982 by Ger [12], then another series was reported by Schultz in 1990 [6].

The preperitoneal transabdominal procedure (TAPP) implemented in surgical practice in 1991 by M. Arregui [1] and deepened in 1992 by Dion and Morin [13], is based on the Stoppa technique concept by which the prosthesis strengthens the transversalis fascia from the level of the entire myopectineal orifice through preperitoneal approach [4]. The total extraperitoneal process (TEP) was described in 1993 by McKernan and Dulucq [1].

The laparoscopic approach of primary hernias of the anterior abdominal wall and incisional defects was first described by LeBlanc and Booth in 1993 using for strengthening the wall a prosthesis positioned intraperitoneally, over the parietal defect, without closing it [14].

Since the introduction of the laparoscopic technique until now there have been a multitude of studies and publications about the benefits and inconveniences of this type of approach, but also articles comparing the advantages and disadvantages of the classic approach with the laparoscopic one in the surgical cure of elective hernias, while for complicated groin defects the numbers of studies is reduced.

The existing evidence supports the multiple benefits brought by laparoscopic procedures compared to open ones, among which we list:

- it is a procedure that does not achieve tension in the sutures and in the neighboring tissues [6];
- peritoneal insufflation and myorelaxants used in the induction of anesthesia can help spontaneously reduce the herniated organ [15, 32, 35];
- it can be visualized directly and in dynamics the viability of the incarcerated or strangulated intestine [15, 33, 35], thus causing the decrease in the risk of performing an unnecessary exploratory laparotomy [35, 51, 90];
- optimal highlighting of dissection plans that allow obtaining the critical safety image [37];
- intraoperative incidents reduced in number and diagnosis of another type of hernia by visualizing the entire abdominal cavity, including the controlled myopectineal orifice, being able to reveal an occult, femoral, Spigelian or obturator hernia [6, 30, 31, 88, 90, 91, 92];

- prosthetic material strengthens all the myopectinal orifice, thus preventing the recurrence or appearance of other types of hernias [30, 90];
- immediate postoperative pain diminished which requires low consumption of analgesics [30, 31];
- reduction of the period of convalescence and rapid social re-insertion [1, 4, 5, 6, 12, 30, 31, 39, 90];
- decrease in the rate of immediate and late complications, especially the rate of postoperative parietal suppurations [4, 25, 30, 32, 39, 90];
- low incidence of chronic postoperative pain [1, 5, 6, 12, 30, 39];
- reducing the period of hospitalization; [31, 51]
- cosmetic effect [1, 51];
- decrease in the incidence of peri- and postoperative morbidity [5, 30, 33, 92];
- increases the quality of life of the patient, making this procedure to be preferred by almost all patients [4, 37];

Among the main disadvantages attributed to laparoscopic procedures, we list:

- longer operator time; [4, 6, 39, 93, 94];
- the need for general anesthesia with tracheal intubation [37];
- longer doctor's learning curve; [4, 6, 31, 92, 93];
- the need to conduct courses to acquire advanced skills in laparoscopic techniques [32, 33, 34, 37, 92]
- costs higher than those of open techniques [4, 6, 37, 94];
- expensive equipment [94];
- the risk of complications related to the mandatory use of prosthetic materials;
- trained staff and equipment available 24 hours /24 hours.

Some recent studies report that there are no differences between procedures in terms of duration of surgery [89], that the laparoscopic approach has a shorter learning curve than classical techniques [5], and that the associated costs are lower overall in the case of laparoscopy [1].

At this time, the guide of the European Hernia Society (EHS) recommends the use of both types of approaches: classic Lichtenstein and laparoscopic or endoscopic [15]. But because

individual skills and institutional experiences take precedence over evidence-based principles, it seems that minimally invasive techniques are not widely used like classical procedures [14].

Although in the last 10 years minimally invasive techniques have begun to be used also in surgical emergencies such as septic shock with abdominal starting point, peritonitic abdomen, hemoperitoneum (selected cases), mesenteric ischemia (at the first intervention or "second look" to check intestinal viability) [16], however, the use of laparoscopic techniques in the surgical treatment of complicated groin hernias (incarcerated or strangulated) is still intensely debated, both because of the high risk of developing iatrogenic lesions [17] and because of the probability of developing postoperative complications with a variable incidence between 0.05% and 8% [16].

Publications about laparoscopic emergency treatment of complicated groin hernias are reduced, although some of their benefits have been proven, such as: peritoneal insufflation together with myorelaxants administered at the induction of anesthesia can help reduce the herniated organ; the viability of the incarcerated or strangulated intestine can be visualized directly and in dynamics [17], thus avoiding an unnecessary laparotomy; and depending on the experience and skills of the surgeon, intestinal resection can be done simultaneously with the correction of the parietal defect.

Complicated cases with neglected generalized peritonitis or with old intestinal occlusion with major surgical risk and with dilated and edematous bowels, which do not allow the relaxation of the anterior abdominal wall to insufflation in order to create the virtual working space [17], cannot be fully approached laparoscopically, limiting the intervention, if it is nevertheless initiated, to a diagnostic laparoscopy, followed by the surgical cure of the hernia by open approach.

The feasibility and safety of the laparoscopic approach for complicated inguinal and femoral defects is conditioned by: [27, 33, 34, 37, 94]

- knowledge of laparoscopic anatomy of the myopectinal orifice;
- recognition of vital anatomical landmarks in the surgical cure of groin hernias;
- knowledge and safe performance of maneuvers to reduce herniated organs (chelotomy, "push & pull");
- performing a dissection of the hernial sac that would result in obtaining the critical view of safety.

In the last 20 years, surgical practice has undergone major changes due to the modernization and adaptation of the methods and equipment necessary for the treatment of surgical pathologies, so that surgeons are forced to train and acquire a wide range of new knowledge and additional skills in the shortest possible time [18].

Major objective

The paper aims to compare the advantages and disadvantages of the laparoscopic approach with the classic one in the surgical treatment of the inguinal and femoral hernias in emergency in terms of improving the patient's quality of life, in order to determine the most appropriate indication of a type of procedure in the light of certain individual circumstances and the results obtained after each approach, because there is a great need for studies that clearly delineate the use of a certain technique according to the particularities of each case.

General objectives

Comparative evaluation and statistical analysis according to the surgical technique and the type of complication of the hernias (incarceration / strangulation) of the following variables:

- the distribution of sex according to the types and subtypes of anterior parietal abdominal defects;
- symptomatology of the patient;
- the visceral organ involved in incarceration or strangulation;
- prosthetic material and its means of fixation, highlighting their advantages and disadvantages;
- the duration of the surgical intervention and implicitly of the learning curve;
- the types of anesthesia administered;
- type and duration of administration of antibiotics and analgesics;
- "Pain Score" – comparative evaluation of immediate postoperative pain in terms of analgesic needs
- duration of resumption of intestinal transit for postoperative gases and feces;
- incidence of intraoperative complications: lesions of the bladder, large or small intestine, funicular vessels; significant hemorrhages (damage to iliac vessels,

spermatic vessels, lower epigastric artery), peritoneum insufficient to cover the prosthesis;

- incidence of postoperative complications (acute retention of urine, immediate and chronic pain, hematoma, seroma, parietal suppuration, recurrence),
- the rate of conversion to laparotomy;
- period of hospitalization;
- incidence of morbidity and mortality according to the surgical approach selected;
- the cost-benefit ratio and costs (direct, indirect and total) in relation to the technique used.

Material and method

In order to achieve the objectives of this thesis, we conducted a retrospective, observational, non-abdominal, unicentric study, spread over a period of 5 years (May 2012 – December 2017) in which 245 patients with unilateral primary and recurrent inguinal and femoral hernias, complicated (incarceration and strangulated) were enrolled, operated by three surgeons from the Surgery Clinic I of the Bucharest University Emergency Hospital who practiced both surgical procedures: Lichtenstein II and TAPP.

The approval of the Ethics Commission of the Bucharest University Emergency Hospital for data collection and processing was obtained (application number 29690 / 23.06.2020, approval number 31673 / 01.07.2020). The data was collected from the observation sheets, the operating protocols and the hospital's InfoWorld system.

The data recording was done using the Microsoft Office program. The statistics were obtained using the Statistical Package for the Social Sciences version 26 (SPSS v26).

For the clinical and demographic data of the patients, descriptive statistical indicators were calculated. Qualitative data were reported as frequencies (in the form of numbers and percentages), and for their statistical processing were used the chi-squared and Fisher exact tests.

Quantitative data were reported as medians with the associated interquartile interval, respectively averages with (\pm) the standard deviation. And for their processing, depending on the observance of a normal distribution or not, it was opted for the use of the Student T test or for the non-parametric tests Mann Whitney U or Kruskal Wallis.

Also, predictor variables for the duration of hospitalization were determined using multiple regression. At the same time, the Boferroni correction was used for multiple tests.

A value $p < 0.05$ was statistically significant.

Thesis structure

The thesis is structured in eight chapters. The first chapter synthetically addresses the surgical anatomy of the inguinal canal from the perspective of both classical and laparoscopic technique.

The next chapter describes the two surgical procedures compared in this study: Lichtenstein II and TAPP, with tips and tricks for situations that may occur during the intervention. Also listed are the incidents and accidents that can occur intraoperatively, their causes of production and their treatment, the early and late systemic and local postoperative complications for each technique, but also the complications specific to the laparoscopic approach of the inguinal and femoral hernias.

The third chapter deals with the importance of diagnosis in the selection of complicated inguinal and femoral hernias that can be solved by laparoscopic approach, the positive diagnosis being made on the clinical and paraclinical elements (laboratory investigations and imaging diagnosis in complicated hernias)

The properties and deficiencies of prosthetic materials and their fixation devices used in the treatment of groin defects are briefly described in chapter four.

Headings 5 to 8 represent the special part of this thesis with the general objectives, the working hypotheses, the research methodology, the results obtained from the statistical processing of the collected data and the discussions related to each objective of the study, but also the conclusions and personal contribution.

Results and discussions

Due to the peculiarities given by sex, men are more likely to develop inguinal hernias, and women to femoral hernias, with a male / female ratio of 9:1.

Inguinal hernias are much more frequent than femoral hernias (98% versus 2% in the case of the studied group), and incarceration is more common than strangulation (87.3% versus 12.7%), predominantly for inguinal hernias compared to femoral hernias.

The male sex is more frequently prone to incarceration than to strangulation (94.4% vs. 67.7%), while women have an increased risk of strangulation of the hernias (32.3% vs. 5.6%).

The median age of patients with complicated inguinal and femoral hernias is 56 years, that of the female sex is 70 years, and for the male sex 56 years, so we can say that women aged 70-89 years and men aged between 40-69 years have a predisposition to develop inguinal and femoral hernias that can be complicated.

Incarceration has the peak of incidence in the age group 50-59 years (the median age of patients with incarcerated hernias in the study was 55 years), and strangulation at 70-79 years (the median being 66 years), the difference being statistically significant ($p < 0,001$), while patients under 40 years did not present strangulated hernias, but only incarcerated.

Strangulation is the most common complication of femoral hernias (60%), and in a much smaller percentage it was also found in external oblique hernias (13.1%) and direct hernias (7.8%).

Direct hernias accounted for 26.12% of cases, external oblique hernias 71.84% of cases, and femoral hernias 2.04% of the total number of patients. In women, femoral hernias predominate (100% of femoral defects), followed by direct inguinal (18.75% of the subtype of direct inguinal defects) and only 2.8% of the total subtype of external oblique hernias, and in males more frequent were subtypes of external oblique hernias (97.2% of the total number of external oblique obliques) and direct (81.25% of the total number of direct hernias).

The most common Nyhus class was class II of which 39.3% were incarcerated and 48.4% were strangled. Nyhus Class I had as a complication only incarceration in 5.1% of cases. With a statistical difference close to meaning ($p = 0.051$), we can say that there is still a relationship between the Nyhus classification and the surgical procedure, but it is not possible to specify exactly which of the Nyhus categories makes the difference, given that in about two-thirds of the cases studied the Lichtenstein II technique was used.

In our study were included 219 (89.4%) complicated primary hernias and 26 (10.6%) complicated recurrent hernias. Incarceration was observed as a frequent complication in both primary hernias (87.2%) and recurrent hernias (88.5%), compared to strangulation (12.7% primary hernias and 11.5% relapsed hernias), with no statistically significant difference.

The "gold standard" of the treatment of this pathology is still preferred over minimally invasive techniques in the surgical cure of both elective and especially complicated hernias.

Thus, the Lichtenstein II technique was used in 67.3% of the cases studied, and the TAPP in 32.7% cases. In both types of hernia complication (incarceration and strangulation) the open Lichtenstein II technique was preferred, the difference being statistically significant ($p < 0.001$). The classical approach was preferred both in incarcerated primary hernias (122 cases out of 191) and strangulated (26 cases out of 28), but also in 2/3 of the cases of incarcerated recurrent hernias and in all cases of recurrent strangulated hernias. The age group 60-69 years benefited from the open procedure, and the laparoscopic one was preferred mainly by patients from the age group 50-59 years.

Approximately 70% of the external oblique inguinal hernias and 57.8% of the direct ones were treated by classical approach, compared to the laparoscopic one through which the repair of 42.4% of the direct inguinal hernias and of 30.1% of the external oblique ones were performed. A statistically significant difference between the type of hernia and the chosen surgical technique ($p = 0.090$) was not revealed, so we could conclude that a surgical procedure cannot be associated only with a certain type of hernia.

Localized or generalized abdominal pain is the ubiquitous symptom of complicated inguinal and femoral parietal defects. Vomiting is prevalent in strangulated hernias with a small intestine ($p < 0.001$), with a strangulated / incarcerated hernia ratio of 8 /1. The absence of transit only for gas is twice as common in incarcerated hernias, the absence of transit for gases and faeces was present in 2/3 of the cases of strangulation. The absence of transit for gas and for gases and faeces could not be statistically correlated with the surgical technique chosen for each case ($p = 0.856$), but statistically significant differences were observed in patients with present transit who had a shorter hospitalization period than those with absent transit at presentation ($p = 0.008$), and about two-thirds of the cases that required conversion to laparotomy had as a symptom the absence of transit ($p < 0.001$).

The order of frequency of abdominal viscera contained in complicated hernias is: oment, small intestine, colon and bladder. The oment is the organ most often involved in incarcerated parietal defects (49%), while strangulated hernias affect the intestinal loops or colon.

Although they have proven many advantages over time, however, the use of prostheses in the surgical cure of inguinal-femoral parietal defects raises a lot of controversy, especially due to the risk of its rejection, but also of infection. The materials used to strengthen the posterior wall of the inguinal canal consist of polypropylene of different shapes and sizes, and with

improvements in their fixation, but also polyester. In the laparoscopic approach, materials that have polypropylene as a basic polymer were frequently used, while in the open technique all types of prostheses were preferred. The prosthetic material used and its fixation devices must have a number of qualities and improvements to reduce immediate and especially late postoperative pain, postoperative complications or recurrences. Of these, three-dimensional anatomical prostheses and fibrin glue have very good results in terms of improving the patient's quality of life.

The means of fixation of prosthetic materials are varied: there are prostheses that are self-fixing (self-adhesive polypropylene of 15 x 10 cm; polypropylene with polylactic acid (microgripp) of 15 x 15 cm), but also prostheses that require additional fixation made either by suture threads (resorbable or not), or by staples (tacks) that can be resorbable or made of metal, either with the help of glue (fibrin glue). Although there are a multitude of publications comparing the different fixation devices in an attempt to find the ideal one that does not increase the incidence of chronic pain and recurrence, there are still many controversies and debates on the subject. In the Lichtenstein technique, only suture threads were used to fix the prostheses, and in the TAPP procedure the most common means of fixation was fibrin glue (more than half of the cases), followed by prostheses with microgripps. The other types of fixation devices were used in a percentage of less than 10%.

The duration of laparoscopic surgeries (median 115 minutes) is longer compared to the classical approach (median 85 minutes), but this is influenced by the abilities and experience of each surgeon (the median duration of the operations performed by the surgeon I = 105 minutes is higher than that of the other two who have comparable medians: 90 minutes surgeon II and 82.5 minutes surgeon III, with the mention that the doctor I performed more laparoscopic interventions), but also depending on the type of complication of the hernia (the median duration of the intervention for strangulated hernias was 95 minutes, and that of the incarcerated hernias of 90 minutes, while the strangulated femoral hernias required a longer time of surgical correction compared to the other types of strangulated and incarcerated hernias). The learning curve is similar in both techniques.

Analyzing the duration of the operation by the surgical technique and the type of complication of the hernias, it was noticed that the strangulated hernias corrected by open approach have a longer execution time compared to the incarcerated ones operated by the

Lichtenstein II procedure, and the laparoscopic approach for both types of hernia complication has a median of the duration of the intervention longer compared to the classical technique.

For minimally invasive techniques, the necessary anesthesia is the general one with tracheal intubation, while the Lichtenstein II procedure can benefit from all types of anesthesia, depending on the associated conditions of the patient (general 60%, spinal 33%, local anesthesia 6.7%)

Regarding the ASA classification for quantifying preoperative risk, the patients in our study were distributed as follows: 45% ASA II, 30% ASA III, 18% ASA I and 7% ASA IV. Most of the patients in class ASA IV were operated on by the Lichtenstein II procedure, those in ASA II and III were treated more by classical approach than laparoscopically, and those in class ASA I benefited from both types of surgical procedures almost equally.

In more than half of the patients enrolled in the study, the administration of antibiotic was not required. A quarter of patients with incarcerated hernias benefited from the antibiotic for prophylactic purposes and another quarter received antibiotic for curative purposes. Patients with strangulated hernias benefited from antibiotic prophylaxis in 13% of cases, and antibiotic therapy in 81% of cases, thus finding a statistically significant difference ($p < 0.001$) between patients with incarcerated hernias and those with strangulated parietal defects. Also, patients who required conversion to laparotomy received antibiotic for a longer duration compared to others, the difference being statistically significant ($p = 0.001$).

Patients treated using the Lichtenstein II procedure require the administration of a stronger analgesic and for a longer period of time compared to patients operated on by the TAPP technique. Strangulated hernias benefited from stronger painkillers for a longer period compared to incarcerated hernias.

Patients to whom it was used suture threads when fixing the prosthesis were given all types of analgesic and for a longer period of time compared to other types of means of fixation. Fibrin glue required only algocalmin and algifen as a type of analgesic and with the shortest duration.

The median pain scale for all patients in the study was 5 with IQR [4, 6.5] and the average of 5.36 ± 1.73 . The laparoscopic / classic "Pain Score" ratio is subunit ($4 / 6 = 0.66$), and that of strangulation / incarceration is greater than one ($7 / 5 = 1.4$).

The resumption of intestinal transit is faster in laparoscopic approach (average 1.31 ± 0.73) compared to the classical technique (average 1.9 ± 1.02), obtaining a high Pearson correlation between the duration of resumption of transit for gases and faeces and the period of administration of the analgesic, so that the longer period of administration is, the more the recovery bowel function is slowed down.

Intraoperative complications were present in 7.8% of the total cases studied, the most common being lesions of the small bowel (3.3%), followed by those of funicular vessels (1.6%), peritoneum insufficient to cover the prosthetic material (1.2%), and in an equal percentage of 0.8, large bowel and bladder injuries were observed. In the Lichtenstein II procedure, frequent incidents were lesions of the small bowel, funicular vessels and bladder, and in the case of laparoscopic approach: insufficient peritoneum, small and large bowel injuries. No statistical difference between the chosen technique and intraoperative accidents ($p = 0.917$). Much more common in strangulated hernias compared to incarcerated ones.

13 (68.4%) of patients with intraoperative complications were converted to laparotomy or the repair of the parietal defect was made by open approach (Lichtenstein), compared to 6 (31.8%) of those who had incidents but without the need for conversion, the difference being statistically significant ($p < 0.001$, Fisher exact test). The death occurred in 10.5% (2 cases) of patients with intraoperative complications compared to 89.5% (17 cases) of patients who suffered intraoperative accidents but survived.

The type and frequency of occurrence overall and per each surgical technique of postoperative complications observed in this study is shown in Table 1.

Acute urinary retention is more common in the classical approach (relative risk of 1.3 times higher compared to TAPP), in strangulated hernias (relative risk of 4.2 times higher compared to those incarcerated), in the elderly (average age 66.5 ± 12.7 years vs. 49.2 ± 13.2 years), in patients who received stronger analgesia and over a longer period.

Pain was reported more frequently in patients treated using the Lichtenstein technique (relative risk of occurrence 1.39 times higher compared to TAPP), in strangulated hernias (relative risk of 2.9 times higher than those incarcerated), and in the use of the following means of fixation: suture threads, tacks and self-fixing meshes.

The hematoma was reported in 10 patients treated by Lichtenstein II and in 1 case operated by laparoscopic approach, but also in 3.7% of the incarcerated hernias compared to 9.7% of the

strangulated ones, without statistically significant differences between the appearance of the hematoma and the surgical technique used ($p = 0.108$) or the type of complication of the hernias ($p = 0.150$).

Table 1 Distribution of postoperative complications

Postoperative complications	Frequency of occurrence (% cases)	Lichtenstein II (% of the total number of cases)	TAPP (% of total number of cases)	Statistical difference between processes
Acute urinary retention	44.9	34.7	10.2	$p = 0.003$
Pain	31.8	26.5	5.3	$p < 0.001$
Haematoma	4.5	4.1	0.40	$p = 0.108$
Seroma	8.2	6.53	1.63	$p = 0.319$
Wound infection	2.9	2.9	0.00	$p = 0.099$
Recurrence	0.8	0.4	0.4	$p = 0,547$

Postoperative seroma developed in 9.7% of the patients operated by the classical procedure and in 5% of the cases corrected by laparoscopic technique ($p = 0.319$), in 7% of the incarcerated hernias and 16.1% of the strangulated ones, without significant differences ($p = 0.083$).

After the Lichtenstein II procedure, there were 7 cases (4.2%) of wound infection and no case after TAPP, but the difference was not significant ($p=0.099$), but patients with strangulated hernias (9.7%) have a relative risk of 3.6 times higher than those with incarcerated hernias (1.9%) of developing this complication ($p=0.045$).

Recurrence rate with comparable values for both types of surgical procedures. Only two cases of hernia recurrence were reported, one after the open approach (representing 0.6% of the cases operated by the Lichtenstein II technique) and one case after TAPP (representing 1.3% of

the total cases corrected by laparoscopic approach) ($p= 0.547$), that two cases being from the group of incarcerated hernias. The average age of patients with hernia recurrence ($53 \pm 14,142$ years) is comparable to the median of patients who have not experienced this complication ($56,98 \pm 15,584$) with a p value of $0,685$.

The laparoscopic approach was preferred by surgeon I (65% cases), followed by surgeon II (21.3%) and III (13.8%). The most comfortable with the Lichtenstein procedure were doctor II (40%) and III (39.4%), while surgeon I used this technique only in 20.6% of cases.

The conversion rate is comparable between the two approaches studied (4.2% for Lichtenstein and 7.5% for TAPP), but with an increased risk for strangulated hernias ($p<0,001$), as shown in Table 2.

Table 2 Distribution of conversion cases by hernia type of complication and surgical procedure

	Number of converted cases (% of total number)	p-value
Total number of converted cases	13 (5.3%)	
Incarcerated hernias	4 (1.9% of incarcerated / 30.8% of the total)	$p<0,001$
Strangulated hernias	9 (29% of the strangled / 69.2% of the total)	
Lichtenstein II	7 (4.2% of the process)	$P=0.286$
TAPP	6 (7.5% of the procedure)	

The causes of conversion to laparotomy were represented by lesions of the small intestine (61.5%), of the colon (15.4%) and peritoneum insufficient to cover the prosthesis (23.1%). The patients operated through the classical approach had as a cause of conversion the lesion of the small bowel in 6 cases and one case of lesions of the colon, and of these laparotomies only in 3 were made intestinal resection. The 3 cases in the group of laparoscopically approached patients in which the flap of the peritoneum was inadequate in dimension to cover the prosthetic material used to strengthen the posterior wall of the inguinal canal, were treated by diagnostic

laparoscopy and then the surgical cure was performed by the Lichtenstein technique. The other 3 cases converted from laparoscopy to laparotomy were due to small and large bowel lesions and required intestinal resection (non-viable, necrotic bowel). Postoperative complications in patients converted to laparotomy were the following: acute urinary retention, chronic pain and wound infection, with significant differences between these cases and those in which conversion was not required ($p = 0.001$ for urinary retention; $p = 0.018$ for pain; $p = 0.004$ for wound infection), while hematoma, seroma and recurrence were more common in patients in whom no additional laparotomy was practiced, but without statistical difference ($p = 0.458$ hematoma; $p = 1,000$ seroma and recurrence).

The average duration of hospitalization of patients in our study was 3.6 ± 2.2 days, and the median was 3 days. The cases operated using the Lichtenstein II procedure had a longer hospitalization period than the patients treated by the TAPP technique (4.08 ± 2.104 days versus 2.70 ± 2.137 days), and patients with incarcerated hernias required a shorter hospitalization compared to the strangulated ones ($3.29 \pm 1,647$ days versus $6.00 \pm 3,706$ days). The duration of hospitalization and convalescent is increased in patients who have received a stronger analgesic and for a longer period, and in those in class ASA IV.

Building a statistically significant model of multiple linear regression ($F(3,241)=1149,562$, $p<0,001$) we found that the variation of the hospitalization period is also influenced in about 93.5% by the duration of surgery ($p = 0.026$), the duration of analgesic administration ($p < 0.001$) and the period of antibiotic administration ($p < 0.001$).

Mortality in the studied group of patients was 0.81% (2 cases), with the following distribution: 0.6% for classically operated cases, 1.25% for those approached laparoscopically; 6.45% of strangulated hernias and no incarcerated hernias. Surgical procedure and postoperative complications do not seem to influence its incidence.

The direct costs (prosthetic material and its means of fixation) are higher in the case of laparoscopic approach compared to the classic Lichtenstein II technique, but the total costs (represented by the sum of the price of the prosthesis used, its fixation device, the anesthesia administered, the surgical intervention and hospitalization) are higher in the classical approach ($p = 0.003$) due to the faster discharge of the patient and the reduced postoperative complications after TAPP.

Conclusions and personal contributions

In order to establish the most appropriate indication of a type of procedure depending on the clinical-biological condition of the selected patients included in the study, but also on the experience of the attending physicians, we conducted a retrospective study, collecting and analyzing the data with the purpose of comparing the advantages and disadvantages of the laparoscopic and classical approach in the treatment of groin hernias in emergency.

The objectives of this research have been achieved as follows:

1. Inguinal parietal defects are more frequent compared to femoral ones, and occur especially in the male sex, in the age group 40 – 70 years, and due to the peculiarities given by the sex, femoral hernias are found in a majority percentage in women aged between 70 and 90 years.
2. Incarceration is more common than strangulation and is predominantly found in inguinal hernias, in men, and in the age group 50-60 years, while strangulation is more often reported in femoral defects, in women and in the elderly, over 70 years of age.
3. Of the subtypes of hernias, the external oblique ones predominate in men, and the femoral ones in women, and the most affected anatomical part is the right one. Hernias of class II Nyhus are predominated.
4. The Lichtenstein II technique is still preferred compared to the TAPP procedure in the treatment of both elective and especially complicated hernias.
5. The main symptom of complicated inguinal and femoral hernias is localized or generalized abdominal pain. Vomiting predominates in strangulated hernias with small intestine. The omentum is the organ most commonly involved in incarceration, and the small bowel or colon in strangulation.
6. The prosthetic materials used and their fixation devices have certain improvements that lead to the minimization of immediate and chronic postoperative pain, postoperative complications or recurrences, such as three-dimensional anatomical prostheses and fibrin glue that have very good results in terms of increasing the patient's quality of life.
7. The duration of laparoscopic surgeries is longer compared to the classical approach, being influenced by the abilities and experience of each surgeon, the type of complication of the hernias and the viability of the viscera involved. The learning curve is similar in both techniques.

8. Laparoscopy requires general anesthesia with tracheal intubation, and the open technique can be performed with any type of anesthesia, depending on the associated conditions of the patient.
9. Most patients with complicated groin defects were assigned to classes ASA II and III.
10. In a quarter of the patients with incarcerated hernias, antibiotic prophylaxis was made and in another quarter of the incarcerated defects was administered antibiotic for curative purposes. Most patients with strangulated hernias benefited from antibiotics for curative purposes, especially those converted to laparotomy, antibiotic therapy being needed more frequently in the open approach.
11. Stronger analgesia or increased dose and for a longer period was necessary in patients treated using the Lichtenstein process, in strangulated hernias and in cases where suture threads and metal tacks were used as fasteners.
12. The pain scale had a higher value in strangulated hernias and in those treated by classical approach, with an increased consumption of stronger painkillers and a longer hospitalization.
13. The resumption of intestinal transit is faster in the laparoscopic approach where the need for analgesia is decreased in dosage and duration.
14. The incidence of intraoperative complications varies depending on the chosen technique, having comparable values, but they are much more common in strangulated hernias compared to incarcerated ones.
15. Acute urinary retention is more common in the elderly, in strangulated hernias, after the Lichtenstein procedure, and in patients with an increased consumption of analgesics in dosage and duration.
16. The relative risk of pain is 1.39 times higher after the Lichtenstein process, and 2.9 times higher in strangulation, but also in patients in whom it was used suture threads and non-absorbable staples as a means of fixing the prosthetic material.
17. Without statistical differences between the development of postoperative hematoma and seroma and the type of complication of hernias or the surgical procedure used.
18. Wound infection has a 3.6 times higher risk of development after the treatment of strangulated hernias, especially if bowel resection is necessary and performed simultaneously.
19. Recurrence for both types of surgical procedures does not present values with significant statistical difference.

20. The conversion rate is comparable between the two approaches studied, but with an increased risk for strangulated hernias. The postoperative complications developed by the converted patients were: acute urinary retention, chronic pain and wound infection.

21. The period of hospitalization and convalescence, as well as of reintegration into society is much shorter in patients treated laparoscopically, but also in the case of incarcerated hernias, being influenced by the patient's comorbidities (ASA class), the duration of the surgical intervention and the duration and dose of analgesics administered.

22. Strangulation causes a higher mortality, which does not seem to be influenced by the surgical procedure or postoperative complications.

23. Institutional direct costs are higher for the laparoscopic approach, and the indirect social costs are lower, and consequently, the total costs in emergency laparoscopic techniques do not differ from the classical ones.

Conclusions

Diagnosis of complicated hernias is in the vast majority of cases clinical, especially if the clinical form of presentation is a subocclusive or occlusive syndrome.

Once a hernia is diagnosed, the indication of surgical treatment is firm, and the patient's presentation for the intervention should be as fast as possible, since the rates of morbidity and mortality are much higher in incarceration and strangulation, and especially in the elderly.

Being a frequent pathology, the surgeon must have very good knowledge of surgical anatomy of the inguinal region from the perspective of both classical and laparoscopic approach. The recognition of anatomical landmarks, the protection of vital organs during the surgical treatment of complicated hernias, the knowledge and mastery of the maneuvers of reduction of herniated viscera are the most important parameters for performing a safe surgery with favorable postoperative results.

In choosing the approach and the surgical technique, one must take into account the clinical and biological condition of the patient, the associated comorbidities, the type of parietal defect, the benefits and risks specific to each surgical technique but also to the type of anesthesia, the individual experience of the surgeon but also the institutional one.

One of the advantages of the classic approach is that patients can benefit from any type of anesthesia. Spinal anesthesia, and especially local anesthesia, reduces the duration of

hospitalization and could be used in the concept of "one-day surgery" in elective hernias, not in emergency.

The most important advantage brought by minimally invasive techniques is that they offer a superior overview of the entire peritoneal cavity, allowing the dynamic assessment of the viability of the incarcerated or strangulated organs while the repair of the parietal defect is performed. This addition of the laparoscopic procedure led to a reduction in the number of additional laparotomies after the Lichtenstein procedure performed for the evaluation of the herniated organ. During the surgery, the doctor must consider the opportunity of a conversion to a classic approach or a laparotomy when local conditions require it, without considering that this represents a personal failure of the surgeon.

If a surgeon is not sufficiently familiar with the TAPP technique, a hybrid procedure can be used, that is, the treatment of the hernia will be done by classical approach, and the viability of the strangulated organs can be evaluated by a diagnostic laparoscopy, increasing the patient's quality of life and thus avoiding the possibility of occurrence of incisional hernias.

The laparoscopic approach to complicated parietal defects has seen an increasing curve, in recent years, but it is still underused, although it has important advantages to be performed in an emergency as well.

Intraoperative and postoperative complications are similar for the two analyzed techniques, laparoscopy being superior in terms of chronic pain, acute urinary retention and wound suppuration. Other advantages brought by laparoscopy are: reduced need for analgesia, short hospitalization, rapid social reintegration.

The ideal results of the types of approaches and surgical techniques used in the treatment of complicated groin hernias would be represented by minimal morbidity, nil mortality and improvement of the patient's quality of life.

The study management did not involve additional financial resources that would have determined the extension of its duration, the only costs being represented by the necessary equipment and consumables used: the laparoscopy kit, the prosthetic material and its fastening devices, the open surgery kit and possibly the sealing and vascular cutting devices.

The limits of research

The main limitation of this thesis is the fact that it is a retrospective study, which enrolled a relatively small number of cases that have been selected from a single center, but also the existence of a reduced number of publications based on evidence that have as a subject the treatment of hernias in emergency and which objectively establish the selection criteria for the laparoscopic approach of complicated inguinal and femoral hernias.

Another limitation is that not all surgeons are familiar with minimally invasive procedures or / and the experience in laparoscopic approach to this pathology is limited.

There is no standardization regarding the use of a certain type of material and its means of fixation, there is still a lot of discussion and controversy on this topic both nationally and internationally.

Directions of research

Randomized, multicenter studies should be conducted on large group of patients to establish the conditions under which laparoscopic techniques used in the treatment of complicated hernias prove efficacy, safety, good cost-benefit ratio and results similar to those of the open approach. As a consequence, the selection of cases for laparoscopic technique is essential, comparing the results with the classical approach and the value of randomized trials being reduced.

Given the existence of recent publications about the robotic approach to hernia pathology, I believe that a training program should be implemented for young surgeons and not only, in specialized centers, in order to develop and learn or deepen additional skills necessary for minimally invasive procedures, because surgical technology and techniques are in a continuous modernization.

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