Research Article

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Score-Predictive Scale for Assessing the Risk of Inguinal and Femoral Hernias Incarceration

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ABSTRACT Today, algorithms have been developed for actions after excluding hernia incarceration directly during the patient's hospitalization, but there are no clear recommendations for how to proceed: to offer surgery in this hospitalization or to recommend planned surgical treatment. To answer this question, it is necessary to assume the probability of repeated incarceration. To solve this problem, we have suggested high, medium and low risk of incarceration of inguinal or femoral hernia and determine the optimal timing of surgery.

Key words: risk of incarceration, incarceration of inguinal hernia, incarceration of femoral hernia

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BPH – benign prostatic hyperplasia
IAH – Inta-Abdominal Hypertension
BMI – body mass index
COPD – chronic obstructive pulmonary disease
ASA – (American Society of Anesthesiologists)
WSACS – (World Society of Abdominal Compartment Syndrome)

INTRODUCTION

One of the most dangerous complications of abdominal wall hernias is incarceration. Emergency surgery for strangulated inguinal and femoral hernias has an increased risk of complications and death. Mortality after emergency operations in the treatment of inguinal hernias, according to the literature, averages 5.8% and increases in the older age group [1–3]. After emergency surgery for incarcerated femoral hernias, the risk of death is 7-10 times higher than with inguinal hernias [1, 4].

A strangulated hernia is an absolute indication for surgical treatment, but the problem of treating patients with a strangulated inguinal or femoral hernia, while eliminating all complications of the strangulation, is a separate and quite significant issue. It should be noted that there are very few studies examining the likelihood of primary or repeated hernia incarceration. Moreover, there are no protocols or recommendations for the further management of patients with a repressed strangulated hernia. There are no criteria, according to which surgical treatment within the framework of the current hospitalization is indicated, while to other patients you may recommend treatment as planned. That is why the identification of risk factors that can predict the development of infringement will make it possible to develop a treatment strategy for this category of patients.

LITERATURE REVIEW

To date, most of the existing studies devoted to the treatment of patients with a repressed incarcerated hernia, a comparative analysis of expectant tactics with surgical intervention is carried out, while primarily the quality of life and economic factors are assessed [5, 6]. So, in particular, in the countries of Europe and America, where the surgical treatment of hernias is associated with significant costs, the question "whether it is necessary to operate on an unstable inguinal hernia or dynamic observation is possible" is especially relevant.

Of the small variety of such studies, the work performed in the UK stands out, in which the risk of entrapment of inguinal hernias is assessed by calculating the overall probability depending on the duration of the history of hernia. In the period from 1987 to 1989, 476 patients with hernias were observed (of them - 439 inguinal, 37 - femoral), 34 infringements were diagnosed (22 inguinal and 12 femoral hernias). After 3 months of hernia existing, the total probability of infringement with inguinal hernias was 2.8%, and after 2 years it increased to 4.5%. In femoral hernias, the total probability of entrapment was 22% after 3 months and 45% after 21 months. The likelihood of entrapment in both cases was greatest in the first 3 months, suggesting that patients with a short history of hernia should be prioritized on the waiting list for elective surgery [7].

In a population study conducted in the United States, among men with inguinal hernias, the share of emergency operations was 3.0%, among women - 14.5% [8]. In the Swedish Hernia Registry, the incidence of entrapment of inguinal hernias was 5.1% among men and 17.0% among women [1, 9]. Thus, the frequency of emergency operations in women was 3-4 times higher than in men. In the same study, it was shown that, compared with planned operations, patients with strangulated inguinal hernias are older, more likely to be obese and have a higher score on the *ASA* scale *(American Society of Anesthesiologists)* [8]. In the presence of a femoral hernia, the risk of emergency surgery in men increases from 3.0–5.1 to 28.1%, and in women from 14.5–17.0 to 40.6% [4]. Most of the restrained femoral hernias were in older female patients [10].

The frequency of inguinal and femoral hernias occurring varies significantly according to the reports of all medical institutions in our country during planned and emergency operations, this probably requires clarification.

Of particular interest is another study carried out in the United States, which demonstrated that the risk of entrapment of an inguinal hernia among the male population depends on age; so, for an 18-year-old patient with an inguinal hernia, the risk is 0.272%, while for a 72-year-old patient - 0.034% [11].

On a large statistical sample, scientists from Amsterdam (Netherlands) showed that the risk of entrapment of groin hernias is approximately 4 per 1000 patients per year. The risk factors for entrapment, from the authors' point of view, were: age over 60 years, femoral hernia, and a history of less than 3 months. At the same time, the rates of postoperative complications and mortality during emergency treatment of inguinal hernias were higher in patients over 49 years of age who were operated on later than 12 hours from the moment of infringement, with femoral hernias, with bowel necrosis and having *ASA* class 3 or 4 [12].

A study from India about the risk of entrapment of groin hernias showed that the risk factors useful for predicting complications in an adult patient with an inguinal hernia were age (older age group), duration of hernia (history of hernia less than a year), type of hernia (more femoral, than the inguinal) and concomitant disease. In children, risk factors were age (infants), gender (male), short history, and right-sided hernia location [13].

In a study by *R.J. Fitzgibbons* (2006) in 720 men with minimal symptoms or asymptomatic inguinal hernias, the follow-up of patients with surgery and expectant management were assessed [14]. During the observation period for two years, there was one infringement of the hernia, over the subsequent period - another

infringement after 4.5 years, as a result, the risk of infringement was 1.8% per 1000 people per year. The wait-and-see strategy was found to be safe and acceptable. These same groups were re-examined 7 years later [15]. As a result, 2.4% patients underwent surgery for entrapment of an inguinal hernia. No deaths were recorded. The incidence of entrapped inguinal hernia for the entire cohort was 0.2%. The authors concluded that men with minimal or no symptoms of inguinal hernias should be advised that although expectant management is safe, symptoms may progress and lead to hernia incarceration [14, 15].

A study on inguinal and femoral hernias in women, carried out in Germany, found that the frequency of emergency operations in women, amounting to 14.5-17.0%, is 3-4 times higher than in men, and in the case of femoral localization the incidence of infringement reaches 40.6% [16].

In addition, there is evidence that femoral hernias in patients are often asymptomatic until the moment of infringement [17]. Similarly, a British study found that 81.5% of patients who underwent emergency surgery for a femoral hernia first complained of a hernia to a general practitioner within a week before hospitalization [18].

RESULTS

Thus, in the literature, the risk of hernia incarceration was most often associated with female sex, age, duration of hernia, and obesity. However, it should be noted that the existing studies did not separately consider the groups of patients with expanded hernias, and also did not study the criteria for predicting the risk of re-infringement.

The high incidence of complications of groin hernias in women is due to anatomical features and is associated with a significant difference between the diameters of the inner inguinal rings, which were almost twice as large in men, while the width of the rectus abdominis muscle was significantly greater in women [16, 19]. These anatomical differences may explain why women may have a significantly lower risk of developing an inguinal hernia than men but a higher incidence of strangulation. Age is another risk factor: with increasing age, the frequency of infringement increases [20, 21]. This is most likely due to the fact that the total number of patients with hernias increases with age.

In a population-based study from the United States, a correlation was found between body mass index (BMI) and inguinal hernias. Compared to normal BMI (20-24.9 kg / m^2), a lower BMI is associated with a higher level of diagnosis. In obesity (BMI ⩾30 kg / m^2), the authors noted a lower diagnosis of inguinal hernia. This inverse relationship may be related to the limitations of physical examination in obese patients [21, 23]. Correlation was confirmed by data from the Swedish hernia register [24].

A high level of intra-abdominal pressure is also considered a risk factor for the development of entrapment. A database study of 1,500,000 people showed an increased risk of hernias in patients with occupational physical activity. Also, an increase in intra-abdominal pressure is noted with coughing, jumping and an increase in BMI, which can provoke the occurrence and complications of inguinal hernias [21, 25, 26].

Of considerable interest is a study that assesses the factors that increase the risk of bowel necrosis in case of hernia incarceration. The study included 102 patients (60 men, 42 women) who underwent hernia surgery in the emergency department of the Kartal Educational and Research Hospital (Shanghai, China) between April 1997 and April 2001). As a result, the following conclusions were obtained: bowel resection was required more often in women, patients over 65 years old and patients with femoral hernias (p <0.05 for all). It should be noted that strangulated hernias were more common in men, but bowel resection was more often required in women. Patients undergoing bowel resection have a higher overall incidence of complications associated with wound infections, but not an increased risk of other complications or mortality [27].

DISCUSSION

As noted in the introductory part of the work, we set the following task: to develop differentiated tactics in the treatment of patients with a reduced restrained inguinal or femoral hernia based on objective criteria. To implement this task, it was decided to propose to develop a point-prognostic scale for assessing the risk of entrapment of inguinal and femoral hernias. At the same time, the data obtained as a result of literary analysis, information from open European and American herniological registers, as well as our own clinical base, which numbers about 2,500 patients treated from 2000 to 2020, were taken into account. The factors

that are important in calculating the probability of primary and repeated infringement of a hernia of the inguinal region were identified and analyzed:

1) Age - middle and old.

2) Gender: in men, inguinal hernia is more likely to be pinched, in women - femoral.

3) Side of hernia: in the case of unilateral hernias, entrapment is more common on the right. Anatomical substantiation of this factor: a) the right testicle descends later than the left testicle; b) the line of attachment of the mesentery of the small intestine runs from L_2 on the left to the right iliac fossa.

4) Level of entrapment: entrapment is more likely to occur in the inner inguinal ring.

5) Hernia type: Femoral hernias are more likely to be pinched than inguinal hernias.

6) Hernia time: the risk of an inguinal hernia infringement is maximal during the first year from its appearance.

7) Restrained organ: most often the small intestine is infringed, less often the omentum and other organs.

8) The timing of hospitalization for a strangulated hernia is a factor that determines the number of resections of the restrained organ, complications and the mortality rate.

9) Anamnesis: episodes of infringement of a hernia, with spontaneous release, preceding hospitalization without surgery.

10) BMI: A lower BMI is associated with a higher diagnostic rate. In obesity, there was a decrease in the level of diagnostics of an inguinal hernia and an increase in intra-abdominal pressure.

11) Intra-abdominal hypertension: increasing intra-abdominal pressure increases the risk of hernia infringement.

12) Complaints: the appearance and progression of complaints of pain in the hernia area may be associated with the development of complications and are an indication for surgical treatment.

13) Exercise: Work involving constant physical activity or jumping increases the risk of hernias and complications.

14) Chronic diseases that cause increased intra-abdominal pressure increase the risk of hernia complications.

The data obtained were statistically processed and criteria were derived, which made it possible to develop a point-prognostic scale for assessing the risk of entrapment of inguinal and femoral hernias.

At the beginning of our study, a thorough analysis of our own data and literature was carried out on risk factors, causes and frequency of entrapment of inguinal and femoral hernias. Due to this, the main risk factors for infringement and their frequency of occurrence were identified (Table 1).

Table 1

Risk factors for constricted inguinal and femoral hernia and frequency of their occurrence

Risk factor	Frequency of occurrence, *p* (%)
Age (over 45)	43,5
Hernia type (oblique inguinal, femoral)	55,8
Pain complaints	40,2
The timing of hernia	33,5
Anamnesis (episodes of infringement earlier)	50,0
Increased body mass index	23,4
Occupational and social factors (constant physical activity)	35,1
Accompanying illnesses	25,5
Intra-abdominal hypertension	56,5

Further, the risk factors of infringement were ranked according to their importance, depending on the frequency of occurrence in patients. The coefficient of significance for each factor was determined by the following formula:

$$CS=N/\sum N$$

Where N is the rank assigned to the risk factor and corresponds to the frequency of occurrence - *p* (Table 2).

Table 2

Distribution of risk factors for constricted inguinal and femoral hernia by importance depending on the frequency of occurrence in patients

	Frequency of occurrence, *p* (%)	Rank (*N*)	Significance coefficient, SC
Age (over 45)	47,3	47,3	0,13
Hernia type (oblique inguinal, femoral)	50,9	50,9	0,14
Pain complaints	40,2	40,2	0,11
The timing of hernia	33,5	33,5	0,09
Anamnesis (episodes of infringement earlier)	50,0	50,0	0,14
Increased body mass index	23,4	23,4	0,06
Occupational and social factors (constant physical activity)	35,1	35,1	0,10
Concomitant diseases	25,5	25,5	0,07
Intra-abdominal hypertension	56,5	56,5	0,16
Total		362,4	1,00

Then the severity of each risk factor was identified using a quantitative scale, where: 0 - no risk factor in the patient; 1 - slightly pronounced risk factor; 2 - moderately pronounced risk factor; 3 - a pronounced risk factor.

To obtain a score for each risk factor, taking into account the degree of their severity, the coefficient of significance was multiplied by the quantitative characteristic of the degree of their severity, the result was multiplied by 10 and rounded to an integer (Table 3). The total influence of all risk factors available for each individual patient was assessed by the sum of the points obtained.

Table 3

Risk factors score for constricted inguinal and femoral hernia

Criterion	Severity of the criterion	Significance coefficient, SC	Score
Age			
young – 18–44 average – 45–59 elderly – 60–74 senile – 75–90 centenarians – 90+	0 1 2 2 1	0,13	0 1 3 3 1
Gender, type of hernia			
Men: – oblique inguinal hernia – straight inguinal hernia – femoral hernia Women: – oblique inguinal hernia – straight inguinal hernia – femoral hernia	 1 0 1 1 0 2	0,14	 1 0 1 1 0 3
Pain complaints			

– at rest – during physical exertion – when changing body position – no pain	3 2 1 0	0,11	3 2 1 0
The timing of hernia			
< 1 year 1–5 years 6–15 years > 15 years	2 1 1 0	0,09	2 1 1 0
Anamnesis			
– no episodes of infringement before – 1 episode of hernia infringement – 2 or more episodes of infringement	0 1 2	0,14	0 1 3
Body mass index, kg / m^2			
25–30 – overweight 30–35 – first degree obesity 35–40 – second degree obesity >40 – third degree obesity	1 3 3 3	0,06	1 2 2 2
Occupational and social factors			
– regular physical activity – lack of physical activity	1 0	0,10	1 0
Concomitant diseases			
– pulmonary diseases (chronic bronchitis, bronchial asthma, COPD, etc.) – diseases of the abdominal cavity (chronic constipation, BPH, etc.)	1 1	0,07	1 1
Intra-abdominal hypertension (*WSACS*)			
1st degree 12-15 mm Hg.; 2nd degree 16-20 mm Hg; 3rd degree 21-25 mm Hg.; Grade 4> 25 mm Hg	1 1 2 2	0,16	2 2 3 3

Notes: BPH – benign prostatic hyperplasia; COPB – chronic obstructive pulmonary disease; WSSACS – classification of intra-abdominal hypertension World Society of Abdominal Compartment Syndrome

Further, using the methods of statistical analysis, the following results were obtained:
— 0-8 points - low probability of hernia infringement, 1–15%;
— 9-15 points - moderate probability of hernia infringement, 16–25%;
— 16-22 points - high probability of hernia infringement, 26–50%.

CONCLUSIONS

The revealed patterns, which are reflected in the proposed point-prognostic scale, made it possible to distinguish the following groups of patients: with a high, moderate and low risk of entrapment of an inguinal or femoral hernia. At the same time, surgical intervention in patients with a high risk of infringement is indicated urgently, within the framework of the current hospitalization, and for patients with an average risk of infringement, priority hospitalization for planned surgical treatment. Such an integrated approach would make it possible to structure and clarify the treatment of patients with a repressed restrained inguinal or femoral hernia, while excluding the complications of the restraint.

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