Research Article
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Prognostic Score for Assessing the Risk of Incisional Ventral Hernias Strangulation

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ABSTRACT. The problem of treatment for strangulated incisional hernia does not lose its relevance due to the large number of postoperative complications and high mortality rates, which significantly exceed these indicators in selective surgery. One of the solutions to this problem is to identify patients with a high risk of strangulation, which will allow you to perform the operation in a timely manner and avoid possible complications. The most relevant issue is the timing of surgery in patients with postoperative hernias after strangulation.

Keywords risk of strangulation; risk factors; incisional strangulated hernia; abdominal wall hernia repair.

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BPH – benign prostatic hyperplasia
IAH – intra-abdominal hypertension
BMI – body mass index
POVH – postoperative ventral hernia
USA – United States of America
COPD – chronic obstructive pulmonary disease
ASA– American Society of Anesthesiologists

INTRODUCTION

Incisional postoperative ventral hernia (POVH) continues to be one of the most frequent complications after laparotomy worldwide [1]. Despite numerous studies on the optimal technique for suturing a laparotomic wound, the risk of developing POVH after a median incision remains in the range of 11–20% [2–4]. This is most likely due to the fact that the technique of closing the median abdominal incisions has remained unchanged for many decades and mainly consists in the usual suturing of the laparotomic wound.

The introduction of laparoscopic techniques into abdominal surgery seemed to solve the problem of POVH formation, but in fact brought with it new technical challenges. One is adequate closure of trocar wounds, especially when large trocars are used or the incision needs to be widened for organ retrieval, leading to trocar hernias. The steady increase in the frequency of these incisional hernias is strongly correlated with an increase in the number and complexity of laparoscopic interventions. According to various estimates, the frequency of trocar hernias and port site hernias ranges from 0.7 to 2.8%, but there is evidence that most of these hernias are asymptomatic and remain undiagnosed [5–10].

The main and more significant problem is that with an increase in POVH freqency, the number of complications of this disease increases, among which the most common is infringement. Surgery for strangulated POVH is associated with longer hospital stays, high postoperative morbidity and mortality [11—14].

Most research in this field of surgery is aimed at preventing recurrence after surgical treatment and is associated with the use of various materials to strengthen the postoperative scar [15—18]. Another part of the research is devoted to the problems of the formation of POVG; among the risk factors are: hereditary causes associated with impaired collagen metabolism and concomitant diseases, such as aortic aneurysm, hernias of various localizations, etc.; age; obesity; comorbidities that increase intra-abdominal pressure [19—24]. And there are practically no studies on the risk of infringement of POVH, although there are emergency operations that have the greatest number of negative consequences. Issues related to risk factors for infringement are not widely discussed, although the problem, due to the increase in morbidity, has not lost its relevance for many years. Another issue that needs to be studied is the tactics of treating patients with POVH after incarceration and the timing of the operation in this category of patients. We will consider the answers to these questions in the present study.

LITERATURE REVIEW

A study performed in Germany and including 2983 patients showed that the average incidence of incisional hernias over a 10-year period was 18.7%. At the same time, 31.5% of all incisional hernias were formed in the first 6 months after surgery, 54.4% – after 12 months, 74.8% – after 2 years and 88.9% – after 5 years. Significant factors influencing the incidence of incisional hernias were age (over 45 years), male sex, preoperative factors: anemia (Hb less than 100 g/l) and body mass index (BMI) over 25 kg/m2, repeated operations and previous laparotomies, as well as postoperative factors: catecholamine therapy and impaired wound healing. Thus, the authors concluded that, compared with demographic and endogenous risk factors, surgical technique has less effect on laparotomy wound healing [3].

Another study, based on the analysis of literature data, showed that the overall incidence of incisional hernias after laparotomy was 9.9%. The incidence was statistically significantly higher for midline incisions compared with transverse ones (11% vs. 4.7%; p=0.006). The incidence of ventral hernias after laparoscopy was only 0.7%. A summary of all studies comparing laparotomy with laparoscopy showed a significantly higher incidence of incisional hernia after laparotomy (p=0,001). Risk factors for the development of incisional hernias were age and infectious complications. A review of the literature showed that only the choice of access can significantly reduce the incidence of ventral incisional hernias [25].

In a study of emergency hernia repair conducted at 16 US Veterans Medical Centers between 1998 and 2002, it was shown that patients with strangulated hernias were of an older age group (p = 0.02), more often black people (p = 0, 02) and had congestive heart failure (p=0.001) or chronic obstructive pulmonary disease (COPD) (p=0,001). After emergency surgical interventions, postoperative complications developed more often, 26.0% patients (p=0.002) had longer hospital stays (p=0.003), and mortality was 14.3% [12].

According to the Danish National Patient Registry, 10,041 elective and 935 emergency ventral hernia repairs were performed between 2007 and 2010. The risk of death, reoperation and recurrence was significantly higher (2–15 times) after an emergency intervention than after a planned one ($p \leqslant 0.003$), in addition, there were significantly more patients with concomitant bowel resection. Independent risk factors for emergency surgery for postoperative hernia were: female gender, advanced age, hernia defects up to 7 cm ($p<0,05$) [26].

A study conducted in Turkey from 1999 to 2008 included 124 patients who underwent emergency ventral hernia surgery. The average time of hernia carrying was 5 years. In the postoperative period, 4 patients died - 3%. The frequency of complications was significantly higher in patients with concomitant diseases, older age group and high scores ASA [27].

Focusing on numerous studies, another high-risk group for developing POVH is obese patients. In patients with a BMI of 30 or more, the incidence of incisional hernia 12 months after midline laparotomy is 22% [3, 28]. In addition, in this group of patients, the likelihood of infringement of POVH is higher, the likelihood of postoperative complications also increases, and in combination with other concomitant diseases, mortality increases [29].

Another study should be noted, the purpose of which was to identify the radiographic features of ventral hernias associated with an increased risk of intestinal incarceration. In univariate analysis, the following indicators were associated with emergency surgery: older age, higher ASA score, increased BMI, ascites, larger hernias, small angle between the hernia sac and the abdominal wall. In multivariate analysis, the following indicators were independently associated with emergency surgery: morbid obesity, ascites, greater height of the hernia sac, and a smaller angle between the hernia sac and the abdominal wall. The authors made the following conclusions: intestinal strangulation occurs in ventral hernias of all sizes, a higher position of the hernial sac and a smaller hernia angle are associated with strangulation, for patients with risk factors, the possibility of early elective surgery should be considered [30].

DISCUSSION AND RESULTS

Given the small number of works in the available literature that evaluate risk factors for the development of infringement of POVH and the complete absence of data on repeated incarcerations and the tactics of treating patients with hernias after incarceration, and most of the studies on risk factors are based on authors own material, we conducted a retrospective analysis of case histories 990 patients treated from 2000 to 2020 with a diagnosis of strangulated postoperative ventral hernia. Thanks to the analysis, the main factors that are important in the development of a score-prognostic scale for assessing the risk of infringement of postoperative ventral hernias were identified:

1. Age – over 55 years old.
2. Gender – Female.
3. The size of the hernial protrusion – from 2 to 7 cm, W 1–2 according to the classification of the European Society of Herniology (EHS), 2009.
4. Localization – median line, (M) according to the classification of the European Society of Herniology (EHS), 2009.
5. History: POVH recurrence increases the risk of strangulation, R1 according to the classification of the European Society of Herniology (EHS), 2009.
6. Timing of hernia: the risk of incarceration of POVH is higher during the first 5 years.
7. BMI: with an increase in BMI, the risk of infringement of POVH increases.
8. Intra-abdominal pressure: in hypertension risk of strangulated hernia increases.
9. Clinical symptoms: the appearance of complaints of discomfort, pain in the area of the hernial protrusion, signs of a chronic violation of the intestinal passage in the hernial sac and episodes of infringement may indicate the development of complications.
10. Work associated with constant physical activity.
11. Concomitant diseases that increase intra-abdominal pressure - chronic lung diseases (COPD, bronchitis), constipation, ascites, diseases of the genitourinary system (prostatitis, benign prostatic hyperplasia, etc.).)

To develop a score-prognostic scale for assessing the risk of infringement of POVH, the frequency of occurrence of factors influencing the development of this complication was determined (Table 1).

Table 1

Risk factors for postoperative ventral hernia strangulation and their incidence

Risk factors	Frequency occurrence, p (%)
Gender (Female)	73,5
Age (over 45)	70,4
Type of hernia (median hernia, above the umbilicus)	62,3
Hernia size (from 2 to 7 cm)	55,8
Pain complaints	45,3
Terms of hernia (up to 5 years)	38,4
Anamnesis (episodes of infringement earlier)	35,8
BMI over 30 kg /м2	54,3
Constant physical activity	33,4
Concomitant diseases that increase intra-abdominal pressure	28,8
Intra-abdominal hypertension	63,4

Note: BMI – Body Mass Index

To determine the coefficient of significance (SC), each risk factor was assigned a rank (N), the value of which is equal to the frequency of occurrence (p) (Table 2). And the short circuit calculation for each factor was determined using the formula below:

$$SC=N/(\sum N)$$

Table 2

Distribution of risk factors for postoperative ventral hernia strangulation by importance depending on the frequency of occurrence in patients

Risk factor	Frequency occurrence, p (%)	Rank (N)	Significance factor
Gender (Female)	73,5	73,5	0,13
Age (over 45)	70,4	70,4	0,13
Type of hernia (median hernia, above the umbilicus)	62,3	62,3	0,11
Hernia size (from 2 to 7 cm)	55,8	55,8	0,10
Pain complaints	45,3	45,3	0,08
Terms of hernia (up to 5 years)	38,4	38,4	0,07
Anamnesis (Episodes of infringement earlier)	35,8	35,8	0,06
BMI over 30 kg/m2	54,3	54,3	0,10
Constant physical activity	33,4	33,4	0,06
Concomitant diseases that increase intra-abdominal pressure	28,8	28,8	0,05
Intra-abdominal hypertension	63,4	63,4	0,11
Sum		561,4	1,00

Note: BMI— Body Mass Index

In order to reduce the available data to point values, the severity of each risk factor was presented in a numerical value, where: 0 - no risk factor; 1 - the severity of the risk factor is insignificant; 2 - the severity of the risk factor is moderate; 3 - the severity of the risk factor is high. Then the degree of severity of each risk factor was multiplied by the coefficient of significance and by a factor of 10, followed by rounding the result to an integer (Table 3). The resulting number for each risk factor is its score equivalent. To obtain the overall impact of the existing risk factors for infringement of POVH, it is necessary to add up the available scores indicated in the table 3. It should be noted that when the hernia is located in several anatomical regions, a score is used for the hernia that has the largest dimensions. Also, if the patient has concomitant diseases of both the respiratory system and the abdominal cavity, then the points are summed up.

Table 3

Risk factors scoring for postoperative ventral hernia strangulation

Risk factors	The severity of the risk factor	Significance factor	Score
Gender:		0,13	
Mail	0		0
Femail	1		1
Age (years):		0,13	
Young age – 18–44	0		0
Middle age – 45–59	1		1
Elderly age – 60–74	2		3
Senile age – 75–90	2		3
Long-livers – 90+	2		3
Type of hernia, according to classification EHS, 2009 r.:		0,11	
1. Median hernias (M): M1 – subxifoid M2 – epigastric M3 – umbilical M4 – infraumbilical M5 – suprapubic	 1 2 2 0 0		 1 2 2 0 0
2. Lateral hernias (L): L1 – hypochondrial L2 – lateral L3 – iliac L4 – lumbar	 0 0 0 0		 0 0 0 0
3. W – hernia gap width: W1 – < 4 см W2 – 4 – 10 см W3 – > 10 см	 2 1 0	0,10	 2 1 0
4. R – number of previous relapses: R0 – this hernia is the first R1 – first relapse R2 – second relapse, etc.	 0 1 1		 0 1 1
Pain complaints: – at rest – during physical activity – no pain	 2 1 0	0,08	 2 1 0
Terms of hernia: less than 3 years 3–5 years over 5 years	 3 1 0	0,07	 2 1 0

Anamnesis: – there were no previous episodes of infringement – 1st episode of strangulated hernia – 2nd and subsequent episodes of strangulated hernia	 0 1 3	0,06	 0 1 2
Body mass index (BMI) kg/m2: 25–30 – overweight 30–35 – obesity of the 1st degree 35–40 — obesity of the 2nd degree более 40 – obesity of the 3rd degree	 1 2 3 3	0,10	 1 2 3 3
Work associated with constant physical activity: – yes – no	 2 0	0,06	 1 0
Accompanying illnesses: – lung diseases (chronic bronchitis, bronchial asthma, COPD, etc.) – abdominal diseases (chronic constipation, ascites) – diseases of the genitourinary system (prostatitis, BPH, etc.)	 1 1 1	0,05	 1 1 1
Intra-abdominal hypertension (IAH) (WSACS): 1st degree: 12-15 mm Hg.; 2nd degree: 16-20 mm Hg.; 3rd degree: 21-25 mm Hg; 4th degree: more than 25 mm Hg.	 2 2 3 3	0,11	 2 2 3 3

Notes: BPH – benign prostatic hyperplasia; IAH – intra-abdominal hypertension; BMI – body mass index; COPD – chronic obstructive pulmonary disease; WSACS – World Society of Abdominal Compartment Syndrome

The result was evaluated by summing up the scores obtained according to the data in Table. 3:
0-8 points - low probability of strangulated hernia, 1–15%;
9-15 points - moderate probability of strangulated hernia,16–25%;
16-25 points - high probability of strangulated hernia, 26–50%.

CONCLUSION

The emergency treatment of complicated abdominal hernias remains one of the most common and complex surgical emergencies and is associated with a significant burden on healthcare systems worldwide. Knowing the risk factors for the development of infringement, it is possible to prevent this complication in a timely manner, which will reduce the total number of negative consequences of this disease.

The use of a point-prognostic scale for assessing the risk of infringement of POVH makes it possible to identify the degree of risk and the likelihood of infringement. Which in turn helps to determine the optimal surgical tactics and timing of surgical intervention. Thus, patients with a high risk of strangulation should be operated on urgently, including during the current hospitalization. Patients with an average or moderate risk should be operated on in a planned manner in the first place. Patients at low risk can be operated on as planned.

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