Polish Annals of Medicine

Journal homepage: https://www.paom.pl

Research paper

Method for the prevention of postoperative ventral hernias during surgical interventions on the anterior abdominal wall

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Article info

Article history
Received 23 January 2020
Accepted 23 June 2020
Available online 9 September 2020

Keywords
Collagen
Metabolic disorders
Postoperative rehabilitation
Non-traumatic surgery
Medical history

Doi
https://doi.org/10.29089/2020.20.00118

Abstract

Introduction: Postoperative ventral hernia (PVH) is a protrusion of the abdominal organs (intestinal loops, omentum, etc.) beyond the abdominal wall through a postoperative space or a scar. Prevention and treatment of external abdominal hernias is one of the urgent problems of modern surgery. PVH is a serious late complication following surgery found in 5%–14% of patients.

Aim: The aim of the study was to define the most important measures to prevent the occurrence of ventral hernia relapses, as well as to predict the occurrence or relapse by determining collagen content.

Material and methods: The main objective of the study was to formulate the main preventive measures of ventral hernia relapses using a method to determine collagen content. Ultrasound examination of the abdominal cavity was used as one of the safest and most advanced diagnostic methods for PVH diagnostics. During the study, a retrospective analysis of 277 case records was used to determine the main causes of ventral hernia relapses and justify the need to prevent PVH relapses.

Results and discussion: In this study, the authors try to develop a scheme for optimal postoperative rehabilitation of the patients to prevent ventral hernia relapses, ways to prevent PVH recurrences in the experiment and to determine the relationship between the risk of PVH and relapses associated with collagen. A comprehensive study consisting of three stages was conducted.

Conclusions: As a result, a conceptual model was developed to improve the prevention of PVH and its relapses.

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1. INTRODUCTION

About 80 000 plastic operations for hernia repair are performed annually in Kazakhstan, about 170 000 in Russia, more than 500 000 hernia repair operations are performed in the USA, which is almost 15% of all general surgical interventions.[1–3] Most often, a ventral hernia occurs 1–2 years after surgery.[4,5] Postoperative ventral hernia (PVH) mainly develops as a result of surgical intervention on the abdomen: after removal of appendicitis, operations for acute intestinal obstruction or peritonitis; cases of the formation of postoperative hernia after removal of the gallbladder are also common.[6–9]

Hernias often occur after emergency operations, when there is no time to adequately prepare the gastrointestinal tract, after a long tamponade or drainage of the abdominal cavity, when poor-quality suture materials are used or in cases of inflammation and suppuration of the suture.[10–12] Predisposing factors include obesity or malnutrition and improper patient behavior during the adaptive, postoperative period.[13–15] The main objective of the study was to formulate the main preventive measures to prevent the occurrence of ventral hernia relapses, as well as prediction of occurrences or relapses using a method to determine collagen content.

The study objectives included: to establish the most significant causes of ventral hernia relapses using a retrospective analysis and justify the need for PVH recurrence prevention; to develop a scheme of optimal postoperative rehabilitation of these patients in order to prevent ventral hernia relapses; to develop a methodology for prevention of PVH relapses in the experiment; to determine the relationship between the risk of PVH and its relapse associated with collagen since it can be used as a carrier of biologically active substances.[16]

2. AIM

The aim of the study was to define the most important measures to prevent the occurrence of ventral hernia relapses, as well as to predict the occurrence or relapse by determining collagen content.

3. MATERIAL AND METHODS

A comprehensive study consisting of three stages was conducted. To create a theoretical base and a conceptual framework, relevant literature data indexed in the Medline, Embase and elibrary databases (2000–2015) was analyzed at the first stage of the study. The data search criteria included the following keywords: 'ventral hernias,' 'relapse,' 'prophylaxis,' 'treatment.' At the second stage of the study, a retrospective analysis of the archived materials of case histories was carried out using the target population as an example, i.e. individuals 24–84 years old.

Taking into account the data obtained during the previous two stages, a conceptual model for the improvement of PVH and its relapse prevention was created. Regardless of the surgical intervention resulted in postoperative hernia, its prevention includes several issues: treatment and prevention of wound complications in the early postoperative period; administration of fibrinogen and cryoprecipitate to accelerate reparative processes in the wound; correct access choice and non-traumatic operation; thorough aseptic surgery; adequate preparation of the patient before surgery and subsequent rehabilitation; exercise to maintain muscles in proper form; measures to lose excess weight; balanced diet.[17,18]

After any intervention on the abdominal cavity, it is also necessary to follow the recommendations of the attending surgeon, avoid excessive physical activity for 6 months after the intervention and, if necessary, wear a bandage for hernia prevention.

A retrospective analysis of the results of surgical treatment of PVHs over the period of 2010 – early 2016 was performed at the 'Author's Medicine' clinic. The study presents data from 277 case records with various types of hernias, 51 with a diagnosis of PVH and 226 other types of hernias.

A significant predominance of women was observed in the study group: 40 (78.4%) women and 11 (21.6%) men (Table 1).

The age of the patients was from 24 to 84 years. They were divided into 3 groups: (1) from 24 to 45 years (11.8%); (2) from 46 to 65 years (49.0%); (3) from 66 to 84 years (39.2%).

The rate of PVH is the highest in the age category from 46 to 65 years, and is the lowest in the age category from 24

Table 1. Distribution of PVH patients by gender and age.

Age	Gender	
	Women	Men
24–45	3	3
46–65	20	5
66–84	17	3

Comments: Total number of PVH patients 51 (100%), included 40 (78.4%) women and 11 (21.6%) men.

Table 2. Number of examinated PVH patients.

Methods of examination	*N*	%
Ultrasound examination of the abdominal cavity	51	100
Abdominal X-ray examination	3	5.8
ECG	51	100
EGD	9	17.6
Chest X-ray	51	100
Complete blood count, microprecipitation test	51	100
Urinalysis	51	100
Blood biochemistry	51	100
Coagulation test	51	100
ELISA for hepatitis and HIV markers	51	100

Comments: Total number of PVH patients 51 (100%).

to 45 years. Laboratory studies included a complete blood count, urinalysis and blood biochemistry. These studies allow timely detection of metabolic disorders, as well as changes in water-electrolyte and protein balance caused by PVH. Ultrasound examination of the abdominal cavity is one of the safest and most advanced diagnostic methods for PVH diagnostics (Table 2).

The patients were hospitalized for a period of 1 to 11 days. Mean duration of hospitalization was 5.5 days (Table 3).

All the patients with PVH were divided into 6 age groups: (1) from 24 to 33 years; (2) from 34 to 43 years; (3) from 44 to 53 years; (4) from 54 to 63 years; (5) from 64 to 73 years; (6) from 74 to 84 years.

Table 4 shows that the age group most susceptible to relapses is from 64 to 73 years.

4. RESULTS AND DISCUSSION

Summary of the analysis of the history of PVH patients: 32 patients (62.7%) had no history of hernias; remaining 19 patients (37.3%) had a history of hernias, i.e. there is a predisposition to hernias. The less invasive the surgical intervention, the lower the risk of PVH. This means that after laparoscopic abdominal surgery, 7.8% (4 patients) of patients have PVH and 92.2% (47 patients) of patients have PVH after laparotomy surgery.

Determination of collagen content was justified at the stage of preoperative examination of patients requiring laparotomy. Collagen is an integral part of the intercellular matrix (IM) which, together with different cell types in it (fibroblasts, chondroblasts and osteoblasts, mast cells and macrophages), is often called connective tissue.

To determine the relationship between the risk of PVH and its relapses associated with collagen, a study was conducted in 60 patients divided into the study and control groups. There were 22 men (36.6%) and 38 women (63.3%). The study group included 35 patients, of which 18 (51.4%) with small, 12 (34.2%) with medium, and 5 (14.2%) with large hernias. The mean age of the patients was 56 years. The control group consisted of 25 patients without hernias. Patients without PVH were operated on in various medical clinics of Almaty with laparotomic access (for example, open cholecystectomy). The mean age in this group was 54 years. A blood test for collagen content was performed in both groups (Table 5).

Table 3. Duration of hospitalization.

No.	Number of patients	Number of patient days
1	1	1
2	3	2
3	8	3
4	6	4
5	12	5
6	9	6
7	7	7
8	4	8
9	1	11
	Mean patient days	5.5

Table 4. Number of relapses.

Age, y	PVH, *n*(%)				
	1	2	3	4	5
From 24 to 33	–	–	–	–	–
From 34 to 43	6(11.7)	–	–	–	–
From 44 to 53	–	10(19.6)	3(6.0)	–	–
From 54 to 63	8(15.7)	4(7.8)	–	–	–
From 64 to 73	7(13.7)	5(9.8)	4(7.8)	2(3.9)	1(2.0)
From 74 to 84	1(2.0)	–	–	–	–

Table 5. Normal collagen content (limits of determination: 65%–101%).

Group	Mean collagen levels, %
With PVH (study group)	27.3–55.4
Operated on, without PVH (control group)	60.2–76.4

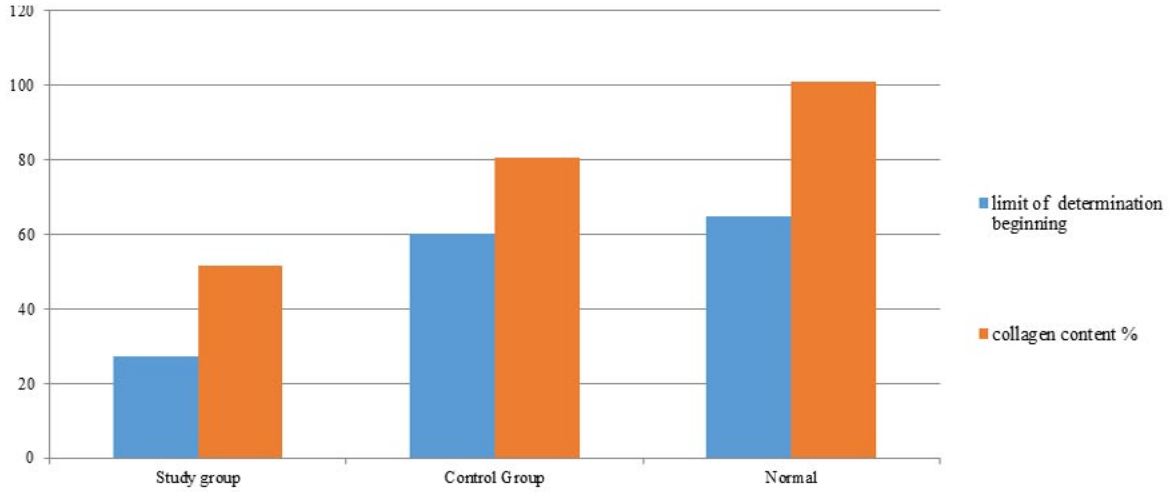

Figure 1. Comparative analysis results of the study groups.

After collagen tests, patients with PVH underwent surgery to treat PVH using a synthetic prosthetic mesh, Ultrapro, Physiomesh, Prolene, which were chosen individually based on the constitution, social status and practicality. Hernia repair procedures were performed at the MC 'Author's Medicine.' Outpatient forms were created for these patients to ensure patient monitoring over the period from 2013 to 2015. A comparative analysis of the data obtained showed that collagen content was either significantly reduced (study group) or was near the lower limit (control group) in the patients from the study and control groups (Figure 1).

During the observation period, no PVH relapses were observed. The data presented in this study give the practical surgeons a possibility to determine PVH risks and to make an informed choice of the optimal method for the treatment of ventral hernia in each patient.

5. CONCLUSIONS

The following conclusions can be made based on this study results:

(1) The earlier the intervention is performed the less changes occur in the tissues and organs; a surgical intervention itself is less complicated and more effective. In a smooth course and healing after the first operation, a postoperative hernia can be repaired after 6, 8, 10 months.
(2) If the history shows a severe postoperative period due to extensive suppuration in the wound, a longer period is necessary, approximately 12–18 months. Wearing of a well-fitting bandage should be recommended.
(3) The outcome of surgical treatment of PVH largely depends both on local factors in the lesion focus and on the general condition of the body and its ability to overcome disorders caused by surgery. Patients with such disorders can benefit from adequate wound draining and various medications that can reduce the damaging effects of surgical trauma.
(4) The lower collagen type I levels significantly affect the development of PVH. It is possible to reduce the incidence of PVHs through early diagnosis of the risk factors of lower collagen levels at the outpatient stage during preparation for laparotomy.
(5) An adequate analgesia can improve the outcome of surgical treatment. An alternative and effective method of pain relief is constant wound irrigation with a local anesthetic in the postoperative period. The use of a single bolus is not effective due to the limited duration of action. A long-term administration of the drugs is carried out through a special catheter installed by the surgeon at the desired location at the end of the surgery. This technique allows the use of a prolonged wound irrigation as a component of postoperative analgesia during implantation of a polypropylene mesh prosthesis after PVH hernia repair.

Conflict of interest

Authors declare that they have no conflict of interest.

Funding

None.

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All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This article does not contain any studies with human participants or animals performed by any of the authors. The respondents gave their permission for the publication of survey results.

References

1 Zhebrovsky VV, Toskin KD, Ilchenko FN. Twenty years of experience in the treatment of postoperative ventral hernias. *Herald Surg I.I. Grekova*. 2000;2:105–108 [in Russian].
2 Belokonev VI, Fedorina TA, Kovaleva ZV, Pushkin SYu, Nagapetyan SV, Supilnikov AA. *Pathogenesis and Surgical Treatment of Postoperative Hernias*. Samara: GP Perspective; 2005 [in Russian].
3 Kulesza G, Tuyakov B, Braczkowska M, Onichimowski D, Mayzner-Zawadzka E. Paravertebral blockade – Underrated method of regional anesthesia. *Pol Ann Med*. 2014;21(1):63–68. https://doi.org/10.1016/j.poamed.2014.03.002.
4 Biryaltsev VN, Shaimardanov RSh, Filippov VA, Khalilov KhM. *Gernioabdominaplasty: A Guide for Physicians*. Kazan: Idel-press; 2008 [in Russian].
5 Egiev VN. *Not Traction Hernioplasty*. Moscow: Medpraktyka; 2002 [in Russian].
6 Yurasov AV, Fedorov DA, Shestakov AL. Mathematical forecasting when choosing a method for plastic surgery of postoperative hernias. *Ann Surg*. 2002;1:47–51 [in Russian].
7 Sugrue M, Buist M, Lee A, Sanchez D, Hillman K. Intra-abdominal measurement using a modified nasogastric tube: description and validation of a new technique. *Intensive Care Med*. 1994;20(8):588–590. https://doi.org/10.1007/bf01705728.
8 Itani KM, Hur KF, Kim LT, et al.; Veterans Affairs Ventral Incisional Hernia Investigators. Comparison of laparoscopic and open repair with mesh for the treatment of ventral incisional hernia. *Arch Surg*. 2010;145(4):322–328. https://doi.org/10.1001/archsurg.2010.18.
9 Egiev VN, Lyadov KV, Voskresensky PK. *Atlas of Operative Hernia Surgery*. Moscow: Medpraktyka-M; 2003 [in Russian].
10 Podergin AV, Halzov VL. Failures of hernia repair with plastic polypropylene mesh. *Bull Herniology*. 2006;2:149–152 [in Russian].
11 Surkov NA. *Anatomical and Functional Reconstruction of the Anterior Abdominal Wall with its Deformations and Defects. Clinical and Morphological Examination*. Moscow: Institute of Plastic Surgery Cosmetology; 2007 [in Russian].

12 Lyadov VK. *Comparative Evaluation of Materials for Intraperitoneal Placement in the Treatment of Hernias of the Anterior Abdominal Wall. Experimental Clinical Study*. Moscow: Lechebno-reabilitatsionnyy tsentr; 2010 [in Russian].

13 Fedorov IV, Slavin LE, Kochnev AV. Seroma as a complication of abdominal hernia surgery. *Bull Herniology*. 2006;2:195–198 [in Russian].

14 Baranova IV, Bezsmertnyi YA, Bezsmertnaya HV, Postovitenko KP, Iliuk IA, Gumeniuk AF. Analgetic effect of ozone therapy: myths of reality? *Pol Ann Med*. 2020;27(1):62–67. https://doi.org/10.29089/2020.20.00099.

15 Kingnorth A. The management of incisional hernia. *Ann R Coll Surg Engl*. 2006;88(3):252–260. https://doi.org/10.1308/003588406x106324.

16 Glotova IA, Galochkina NA, Selemenev VF, Peregonchaya OV, Sokolova SA. IR-spectroscopic study of immobilization of selenium compounds on biomodified collagen. *Period Tche Quim*. 2019;16(33):159–168. http://deboni.he.com.br/Periodico33.pdf. Accessed: 20.01.2020.

17 Lin Y-T, Weng T-Y, Tam K-W. Effectiveness and safety of mesh repair for incarcerated or strangulated hernias: A systematic review and meta-analysis. *World J Surg*. 2020;44(7):2176–2184. https://doi.org/10.1007/s00268-020-05430-4.

18 De Simone B, Birindelli A, Ansaloni L, et al. Emergency repair of complicated abdominal wall hernias: WSES guidelines. *Hernia*. 2020;24(2):359–368. https://doi.org/10.1007/s10029-019-02021-8.

19 Kjaer M, Frederiksen AKS, Nissen NI, et al. Multinutrient supplementation increases collagen synthesis during early wound repair in a randomized controlled trial in patients with inguinal hernia. *J Nutr*. 2020;150(4):792–799. https://doi.org/10.1093/jn/nxz324.