Structure and frequency of comorbidities and associated postoperative complications: a national observational multicenter study STOPRISK

I.B. Zabolotskikh[1, 2, 3, *], N.V. Trembach[1, 2], M.A. Magomedov[4, 5], A.S. Popov[6], Yu.P. Malyshev[1, 7], A.A. Dmitriev[1], E.V. Grigoryev[8], V.V. Fisher[9, 10], V.E. Khoronenko[11], V.N. Kokhno[12], A.P. Spasova[13], V.R. Davydova[14], A.I. Gritsan[15, 16], K.M. Lebedinskii[3, 17], P.V. Dunts[18], A.Zh. Bayalieva[19], A.M. Ovezov[20], D.V. Martynov[21], N.G. Arikan[22], M.Yu. Kirov[23, 24], V.I. Ershov[25], I.N. Pasechnik[26], A.N. Kuzovlev[3], D.E. Fedunets[1]

[1] *Kuban State Medical University, Krasnodar, Russia*
[2] *Regional Clinical Hospital No 2, Krasnodar, Russia*
[3] *Federal Research and Clinical Center of Intensive Care Medicine and Rehabilitology, Moscow, Russia*
[4] *City Clinical Hospital No 1 named after N.I. Pirogov, Moscow, Russia*
[5] *Russian National Research Medical University named after N.I. Pirogov, Moscow, Russia*
[6] *Volgograd State Medical University, Volgograd, Russia*
[7] *S.V. Ochapovskiy Research Institute Regional clinical hospital No 1, Krasnodar, Russia*
[8] *Research Institute of Complex Problems of Cardiovascular Diseases, Kemerovo, Russia*
[9] *Stavropol Regional Clinical Hospital, Stavropol, Russia*
[10] *Stavropol State Medical University, Stavropol, Russia*
[11] *P.A. Hertsen Moscow Oncology Research Center, Moscow, Russia*
[12] *State Novosibirsk Regional Clinical Hospital, Novosibirsk, Russia*
[13] *Republican hospital named after V.A. Baranov, Petrozavodsk, Russia*
[14] *Kazan State Medical University, Kazan, Russia*
[15] *Regional Clinical Hospital, Krasnoyarsk, Russia*
[16] *Krasnoyarsk State Medical University named after Professor V.F. Voino-Yasenetsky, Krasnoyarsk, Russia*
[17] *North-Western State Medical University named after I.I. Mechnikov, St. Petersburg, Russia*
[18] *Regional Clinical Hospital No. 2, Vladivostok, Russia*
[19] *Republican Clinical Hospital, Kazan, Russia*
[20] *Moscow Regional Research and Clinical Institute, Moscow, Russia*
[21] *Rostov State Medical University, Rostov-on-Don, Russia*

Структура и частота сопутствующих заболеваний и связанных с ними послеоперационных осложнений: национальное наблюдательное многоцентровое исследование STOPRISK

И.Б. Заболотских[1, 2, 3, *], Н.В. Трембач[1, 2], М.А. Магомедов[4, 5], А.С. Попов[6], Ю.П. Малышев[1, 7], А.А. Дмитриев[1], Е.В. Григорьев[8], В.В. Фишер[9, 10], В.Э. Хороненко[11], В.Н. Кохно[12], А.П. Спасова[13], В.Р. Давыдова[14], А.И. Грицан[15, 16], К.М. Лебединский[3, 17], П.В. Дунц[18], А.Ж. Баялиева[19], А.М. Овезов[20], Д.В. Мартынов[21], Н.Г. Арыкан[22], М.Ю. Киров[23, 24], В.И. Ершов[25], И.Н. Пасечник[26], А.Н. Кузовлев[3], Д.Э. Федунец[1]

[1] *ФГБОУ ВО «Кубанский государственный медицинский университет» Минздрава России, Краснодар, Россия*
[2] *ГБУЗ «Краевая клиническая больница № 2» Минздрава Краснодарского края, Краснодар, Россия*
[3] *НИИ общей реаниматологии им. В.А. Неговского Федерального научно-клинического центра реаниматологии и реабилитологии (ФНКЦ РР), Москва, Россия*
[4] *ГБУЗ города Москвы «Городская клиническая больница № 1 им. Н.И. Пирогова» Департамента здравоохранения города Москвы, Москва, Россия*
[5] *ФГАОУ ВО «Российский национальный исследовательский медицинский университет имени Н.И. Пирогова» Минздрава России, Москва, Россия*
[6] *ФГБОУ ВО «Волгоградский государственный медицинский университет» Минздрава России, Волгоград, Россия*
[7] *ГБУЗ «Научно-исследовательский институт — Краевая клиническая больница № 1 им. проф. С.В. Очаповского» Минздрава Краснодарского края, Краснодар, Россия*
[8] *ФГБНУ «Научно-исследовательский институт комплексных проблем сердечно-сосудистых заболеваний», Кемерово, Россия*
[9] *ГБУЗ СК «Ставропольская краевая клиническая больница» Минздрава Ставропольского края, Ставрополь, Россия*
[10] *ФГБОУ ВО «Ставропольский государственный медицинский университет» Минздрава России, Ставрополь, Россия*
[11] *Московский научно-исследовательский онкологический институт им. П.А. Герцена — филиал ФГБУ «НМИЦ радиологии» Минздрава России, Москва, Россия*

[22] *F.I. Inozemtsev City Clinical Hospital, Moscow, Russia*
[23] *Northern State Medical University, Arkhangelsk, Russia*
[24] *First City Clinical Hospital named after E.E. Volosevich, Arkhangelsk, Russia*
[25] *Orenburg Regional Clinical Hospital, Orenburg, Russia*
[26] *Joint Hospital with Polyclinic of the Office of the President of the Russian Federation, Moscow, Russia*

[12] *ГБУЗ НСО «Государственная Новосибирская областная клиническая больница», Новосибирск, Россия*
[13] *ГБУЗ «Республиканская больница им. В.А. Баранова» Минздрава Республики Карелия, Петрозаводск, Россия*
[14] *ФГБОУ ВО «Казанский государственный медицинский университет» Минздрава России, Казань, Россия*
[15] *КГБУЗ «Краевая клиническая больница», Красноярск, Россия*
[16] *ФГБОУ ВО «Красноярский государственный медицинский университет имени профессора В.Ф. Войно-Ясенецкого» Минздрава России, Красноярск, Россия*
[17] *ФГБОУ ВО «Северо-Западный государственный медицинский университет им. И.И. Мечникова» Минздрава России, Санкт-Петербург, Россия*
[18] *ГБУЗ «Краевая клиническая больница № 2», Владивосток, Россия*
[19] *ГАУЗ «Республиканская клиническая больница» Минздрава Республики Татарстан, Казань, Россия*
[20] *ГБУЗ МО «Московский областной научно-исследовательский клинический институт им. М.Ф. Владимирского», Москва, Россия*
[21] *ФГБОУ ВО «Ростовский государственный медицинский университет» Минздрава России, Ростов-на-Дону, Россия*
[22] *ГБУЗ «Городская клиническая больница им. Ф.И. Иноземцева» Департамента здравоохранения города Москвы, Москва, Россия*
[23] *ФГБОУ ВО «Северный государственный медицинский университет» Минздрава России, Архангельск, Россия*
[24] *ГБУЗ АО «Первая городская клиническая больница им. Е.Е. Волосевич», Архангельск, Россия*
[25] *ГАУЗ «Оренбургская областная клиническая больница», Оренбург, Россия*
[26] *Объединенная больница с поликлиникой Управления делами Президента РФ, Москва, Россия*

Abstract

INTRODUCTION: Risk assessment and identification of a group of patients with a high probability of developing an unfavorable outcome is the basis for effective prevention of postoperative adverse events. **OBJECTIVE:** The purpose of the study was to determine the structure and frequency of co-existing diseases in the preoperative period and associated adverse postoperative outcomes. **MATERIALS AND METHODS:** The analysis of the parameters of 8,241 patients of the STOPRISK database operated on abdominal and pelvic organs for the period from July 1, 2019 to April 30, 2022 was carried out. **RESULTS:** Co-existing diseases occurred in 4,638 patients (56.3 %), while one disease was observed in 1,872 patients (22.7 %), a combination of two diseases — in 1,383 patients (16.8 %), three diseases — in 814 patients (9.9 %), four diseases — in 395 patients (4.8 %), and more than 4 — in 170 patients (2.0 %). The most common were arterial hypertension — 48.2 %, chronic heart failure (20.7 %), coronary heart disease (19.3 %). The presence of one or more complica-

Реферат

АКТУАЛЬНОСТЬ: Оценка риска и выделение группы пациентов с высокой вероятностью развития неблагоприятного исхода — основа эффективной профилактики послеоперационных неблагоприятных событий. **ЦЕЛЬ ИССЛЕДОВАНИЯ:** определить структуру и частоту сопутствующих заболеваний в предоперационный период и ассоциированные с ними неблагоприятные послеоперационные исходы. **МАТЕРИАЛЫ И МЕТОДЫ:** Проведен анализ показателей 8241 пациента базы STOPRISK, оперированных на органах брюшной полости и малого таза за период с 1 июля 2019 г. по 30 апреля 2022 г. **РЕЗУЛЬТАТЫ:** Сопутствующие заболевания встречались у 4638 пациентов (56,3 %), при этом одно заболевание наблюдали у 1872 пациентов (22,7 %), сочетание двух заболеваний — у 1383 пациентов (16,8 %), трех заболеваний — у 814 пациентов (9,9 %), четырех заболеваний — у 395 пациентов (4,8 %), более 4 — у 170 пациентов (2,0 %). Наиболее часто встречались гипертоническая болезнь — 48,2 %, хроническая

tions was recorded in 285 patients (3.5 %), fatal outcome — in 36 patients (0.43 %). 74.0 % of patients had a single complication, 14.0 % had a combination of two complications, and 12.0 % had a combination of three or more complications. The structure of complications was dominated by paralytic ileus (25.57 %), pneumonia (12.1 %), wound infection (12.1 %). Both mortality and the frequency of complications increased with an increase in the number of co-existing diseases. **CONCLUSIONS:** The most common co-existing diseases in abdominal surgery are arterial hypertension, chronic heart failure, coronary heart disease, diabetes mellitus and cardiac arrhythmia. The frequency of postoperative complications was 3.5 %, mortality was 0.43 %; the most frequent complications were paralytic ileus, wound infection and pneumonia.

REGISTRATION: Clinicaltrials.gov identifier: NCT03945968. Registered May 10, 2019

KEYWORDS: co-existing diseases, postoperative complications

* *For correspondence:* Igor B. Zabolotskikh — Dr. Med. Sci., professor, head of Department of Anesthesiology, Intensive Care and Transfusiology, Kuban State Medical University, Krasnodar, Russia; head of anesthesiology-reanimatology center in Regional Clinical Hospital No 2, Krasnodar, Russia; Chief Researcher, Federal Research and Clinical Center of Intensive Care Medicine and Rehabilitology, Moscow, Russia; e-mail: pobeda_zib@mail.ru

For citation: Zabolotskikh I.B., Trembach N.V., Magomedov M.A., Popov A.S., Malyshev Yu.P., Dmitriev A.A., Grigoryev E.V., Fisher V.V., Khoronenko V.E., Kokhno V.N., Spasova A.P., Davydova V.R., Gritsan A.I., Lebedinskii K.M., Dunts P.V., Bayalieva A.Zh., Ovezov A.M., Martynov D.V., Arikan N.G., Kirov M.Yu., Ershov V.I., Pasechnik I.N., Kuzovlev A.N., Fedunets D.E. Structure and frequency of comorbidities and associated postoperative complications: a national observational multicenter study STOPRISK. Annals of Critical Care. 2023;3:43–57. https://doi.org/10.21320/1818-474X-2023-3-43-57

Received: 29.04.2023
Accepted: 03.06.2023
Published online: 28.07.2023

сердечная недостаточность (20,7 %), ишемическая болезнь сердца (19,3 %). Наличие одного осложнения и более зафиксировано у 285 пациентов (3,5 %), летальный исход — у 36 пациентов (0,43 %). У 74,0 % пациентов наблюдали единственное осложнение, у 14,0 % — сочетание двух осложнений, у 12,0 % — сочетание трех осложнений и более. В структуре осложнений преобладали парез кишечника (25,57 %), пневмония (12,1 %), раневая инфекция (12,1 %). Как летальность, так и частота осложнений росли с увеличением количества сопутствующих заболеваний. **ВЫВОДЫ:** Наиболее частые сопутствующие заболевания в абдоминальной хирургии — гипертоническая болезнь, хроническая сердечная недостаточность, ишемическая болезнь сердца, сахарный диабет и нарушение сердечного ритма. Частота послеоперационных осложнений составила 3,5 %, летальность — 0,43 %; при этом наиболее частыми осложнениями были парез кишечника, раневая инфекция и пневмония.

РЕГИСТРАЦИЯ: идентификатор Clinicaltrials.gov: NCT03945968. Зарегистрировано 10 мая 2019 г.

КЛЮЧЕВЫЕ СЛОВА: сопутствующие заболевания, послеоперационные осложнения

* *Для корреспонденции*: Заболотских Игорь Борисович — д-р мед. наук, профессор, заведующий кафедрой анестезиологии, реаниматологии и трансфузиологии ФПК и ППС ФГБОУ ВО «Кубанский государственный медицинский университет» Минздрава России, Краснодар, Россия; руководитель центра анестезиологии-реаниматологии ГБУЗ «Краевая клиническая больница № 2» Минздрава Краснодарского края, Краснодар, Россия; главный научный сотрудник НИИ общей реаниматологии им. В.А. Неговского Федерального научно-клинического центра реаниматологии и реабилитологии (ФНКЦ РР); e-mail: pobeda_zib@mail.ru

Для цитирования: Заболотских И.Б., Трембач Н.В., Магомедов М.А., Попов А.С., Малышев Ю.П., Дмитриев А.А., Григорьев Е.В., Фишер В.В., Хороненко В.Э., Кохно В.Н., Спасова А.П., Давыдова В.Р., Грицан А.И., Лебединский К.М., Дунц П.В., Баялиева А.Ж., Овезов А.М., Мартынов Д.В., Арыкан Н.Г., Киров М.Ю., Ершов В.И., Пасечник И.Н., Кузовлев А.Н., Федунец Д.Э. Структура и частота сопутствующих заболеваний и связанных с ними послеоперационных осложнений: национальное наблюдательное многоцентровое исследование STOPRISK. Вестник интенсивной терапии им. А.И. Салтанова. 2023;3:43–57. https://doi.org/10.21320/1818-474X-2023-3-43-57

Поступила: 29.04.2023
Принята к печати: 03.06.2023
Дата онлайн-публикации: 28.07.2023

Introduction

The frequency of adverse outcomes in abdominal surgery is still high. Postoperative complications develop in every fifth patient that significantly affect the quality of life, duration, and cost of treatment, as well as the long-term prognosis [1, 2]. The most significant one is the development of postoperative cardiac complications — about 500–900 thousand cases per 100 million adults 45 years and older who underwent noncardiac surgical interventions [3]. Risk assessment and identification of a group of patients with a high probability of developing an unfavorable outcome is the basis for effective prevention of postoperative adverse events. That is why attempts to develop an effective risk stratification tool are being made by researchers again and again [4]. Currently, a sufficiently large number of factors have been identified that increase the likelihood of developing an unfavorable course of the postoperative period, as well as the risk of developing certain complications.

Despite the wide variety of scales for assessing perioperative risk, the problem has not been completely solved, and the search for a reliable scale continues to this day. The development of a risk stratification system is to find a balance of simplicity and applicability in routine practice on the one hand and accuracy on the other. Modern research in this area is aimed at obtaining the optimal ratio of these qualities. Currently, there are several trends in the creation of risk assessment tools. Firstly, most of the scales are developed based on the identification of risk factors with the search for the most significant ones by the method of logistic regression analysis, and as practice shows, the scales based on the assessment of the structure of concomitant diseases are the most accurate, which indicates the exceptional importance of studying them as predictors of an unfavorable outcome [5]. Secondly, it becomes obvious that already developed tools need mandatory validation, and a simple extrapolation of data from one population to another leads to an inevitable decrease in the accuracy of the forecast [6]. This is due to differences in risk factors and, from this point of view, national studies aimed at identifying the role of preoperative risk factors and comorbidity, primarily in the development of an unfavorable postoperative outcome, are of particular importance.

To this end, in 2019, at the initiative of the Federation of Anesthesiologists and Resuscitators (FAR) of Russia, together with the Kuban State Medical University, a national observational multicenter study of FAR "The role of concomitant diseases in the stratification of the risk of postoperative complications in abdominal surgery — STOPRISK" was launched.

The aim of the study was to determine the structure and incidence of concomitant diseases in the preoperative period and associated adverse postoperative outcomes.

Materials and methods

Data collection

By the time of the analysis of the interim results, data on the perioperative parameters of 8241 STOPRISK patients underwent an abdominal and pelvic surgery from 42 centers representing 8 federal districts for the period from July 1, 2019 to April 30, 2022 were obtained.

All centers were approved by local ethics committees prior to the start of the study. Patients signed a voluntary informed consent to participate in the study.

The study protocol involved collecting information about all patients who met the inclusion criteria for the selected day [7].

Gender-age characteristics, comorbidity, features of anesthesia and surgical intervention were recorded in all patients after assessment of compliance with the inclusion criteria (Figure 1), 30-day complications in the postoperative period according to the classification of the joint working group of ESA (European Society of Anesthesiology) and ESICM (European Society of Intensive Care Medicine) and death were recorded.

The assessment of the presence of concomitant diseases, their incidence, the number of postoperative complications and their incidence; the structure of complications in a group of patients with one complication and mortality; the structure of combined complications and mortality; mortality and the incidence of complications in patients with a different number of concomitant diseases, as well as the structure of combined concomitant diseases in deceased patients. A comparison with other studies on the structure of traumatic operations, the initial physical status was carried out, the frequency of postoperative complications of this study and similar foreign ones.

Registration of the study

The study is registered in the international database https://clinicaltrials.gov under the auspices of the All-Russian Public Organization "Federation of Anesthesiologists and Resuscitators", study number NCT03945968.

Statistical processing

Statistical data processing was carried out on a Lenovo Yoga computer using the MedCalc program, version 19.1.3. The hypothesis of the normal distribution of the studied parameters for all variables was tested using the Kolmogorov-Smirnov criterion. Considering the nonparametric nature of the distribution, the data are presented as a median (25–75 percentiles).

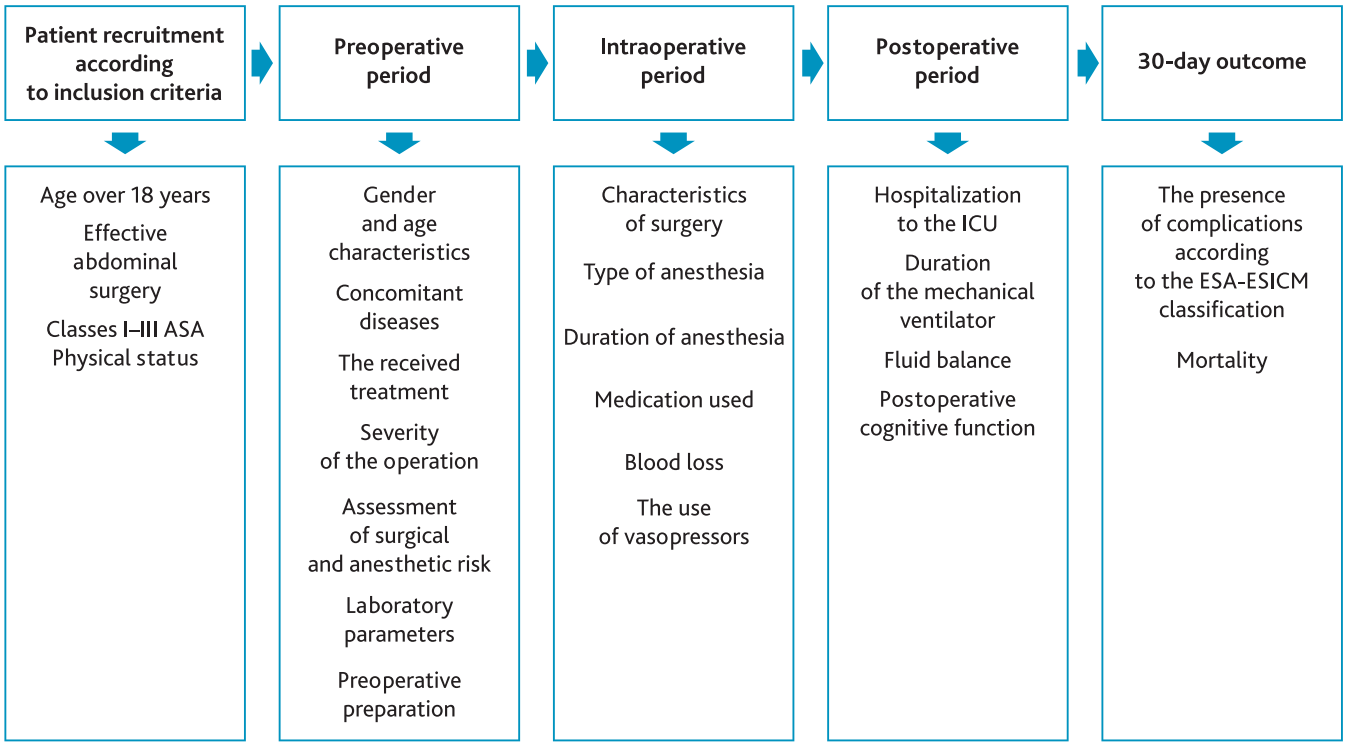

Fig. 1. Scheme of the study

ASA — American Society of Anesthesiologists; ESA — European Society of Anesthesiology; ESICM — European Society of Intensive Care Medicine; ICU — intensive care unit.

The results of the study

The main characteristics of the cohort under study are presented in Table 1.

Table 1. Characteristics of the study cohort (*n* = 8241)

Characteristics	Value
Age, years, Me (p25–p75)	56 (43–65)
Body mass index, kg/м² Me (p25–p75)	26.8 (23.5–30.8)
Sex (males), %	36.5
Class of physical status according to ASA	
I	1327 (16.1%)
II	4244 (51.5%)
III	2670 (32.4%)
Severity of the operation	
Low	3041 (36.9%)
Median	4310 (52.3%)
High	890 (10.7%)

ASA — American Society of Anesthesiologists; Me (p25–p75) — median (p25–p75 percentiles).

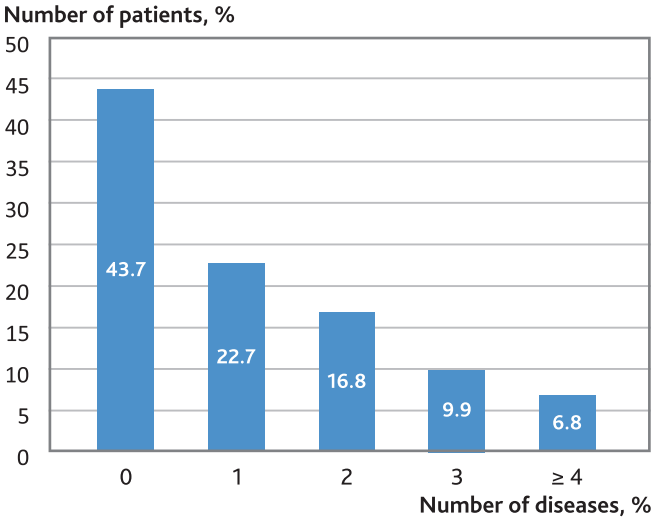

Fig. 2. Structure of the cohort by the number of comorbidities

Concomitant diseases were observed in 4,638 patients (56.3 %), while one disease was observed in 1,872 patients (22.7 %), a combination of two diseases — in 1,383 patients (16.8 %), three diseases — in 814 patients (9.9 %), four diseases — in 395 patients (4.8 %), and more 4 concomitant diseases were detected in 170 patients (2.0 %) (Figure 2).

Arterial hypertension (AH) dominated in the structure of comorbidity in patients with one concomitant disease (CD) — 1471 patients (78.6 %), diabetes mellitus (DM) was observed in 92 patients (4.9 %), congestive heart disease (CHD) — in 75 patients (4 %), chronic obstructive pulmonary disease (COPD) and arrhythmias — in 3 % (62 patients each), bronchial asthma and chronic kidney disease (CKD) — in 2 % (37 and 38 patients, respectively), acute cerebrovascular accident (ACVA) in anamnesis — in 18 patients (1 %), neuromuscular diseases — in 0.8 % (15 patients); epilepsy, Alzheimer's disease and Parkinson's disease — in 0.5 % of patients (10 patients each). In the structure of comorbidity in patients with two CD, a combination of AH with CHF, CHD or DM (more than 65 %) prevailed; in patients with three CD — a combination of PE or chronic heart failure (CHF) with CHD or DM (more than 60 %); in patients with four or more CD — PE, CHD and CHF with DM, arrhythmias, COPD, CKD and ACVA (more than 70 %). Arterial hypertension, chronic heart failure, ischemic heart disease, diabetes mellitus and cardiac arrhythmia were the most common diseases (Figure 3).

The presence of one or more complications was recorded in 285 patients (3.5 %) and fatal outcome in 36 patients (0.43 %).

A single postoperative complication was observed in 74.0 % of patients, a combination of two complications were found in 14.0 % of patients, and a combination of three or more complications were noted in 12.0 % of patients. The structure of postoperative complications was dominated by paralytic ileus — 112 patients (25.57 %), pneumonia— 53 patients (12.10 %), wound infection — 53 patients (12.10 %); anastomosis leakage, arrhythmias, acute kidney injury (AKI), cardiac arrest, postoperative bleeding and postoperative delirium were observed in 5–10 % of cases; acute respiratory distress

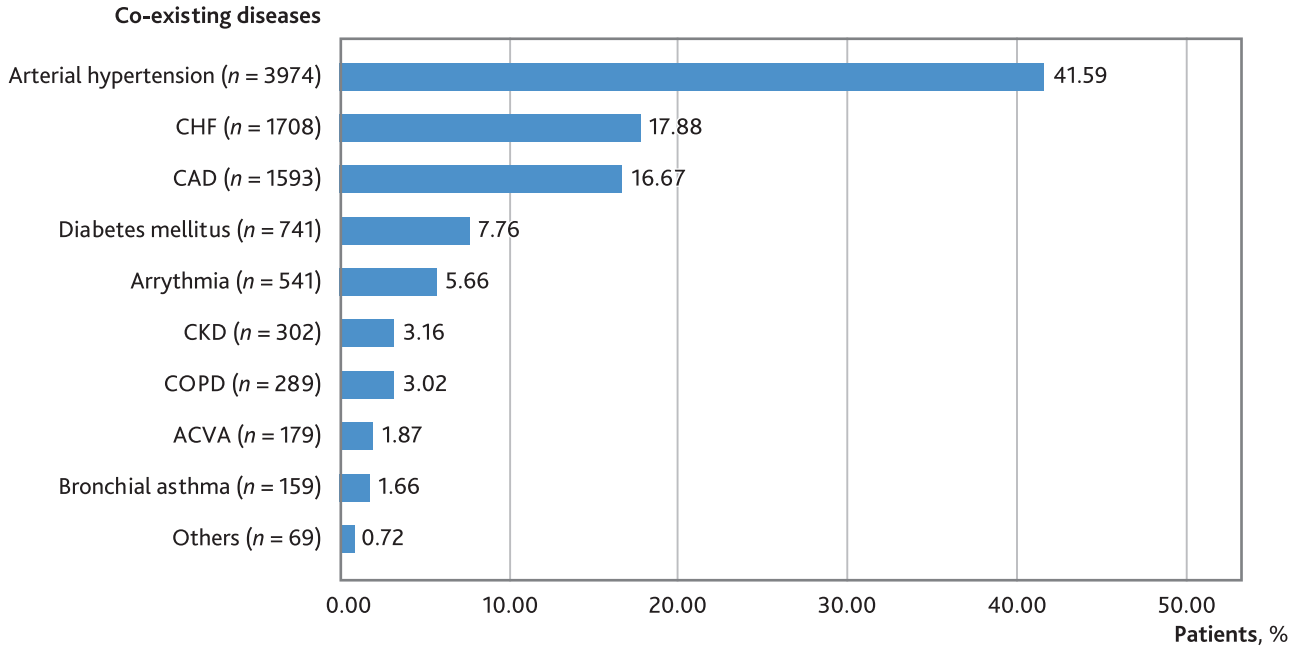

Fig. 3. The incidence of comorbidities

ACVA — acute cerebrovascular accident; CAD — coronary artery disease; CHD — coronary heart disease; CHF — chronic heart failure; CKD — chronic kidney disease; COPD — chronic obstructive pulmonary disease.

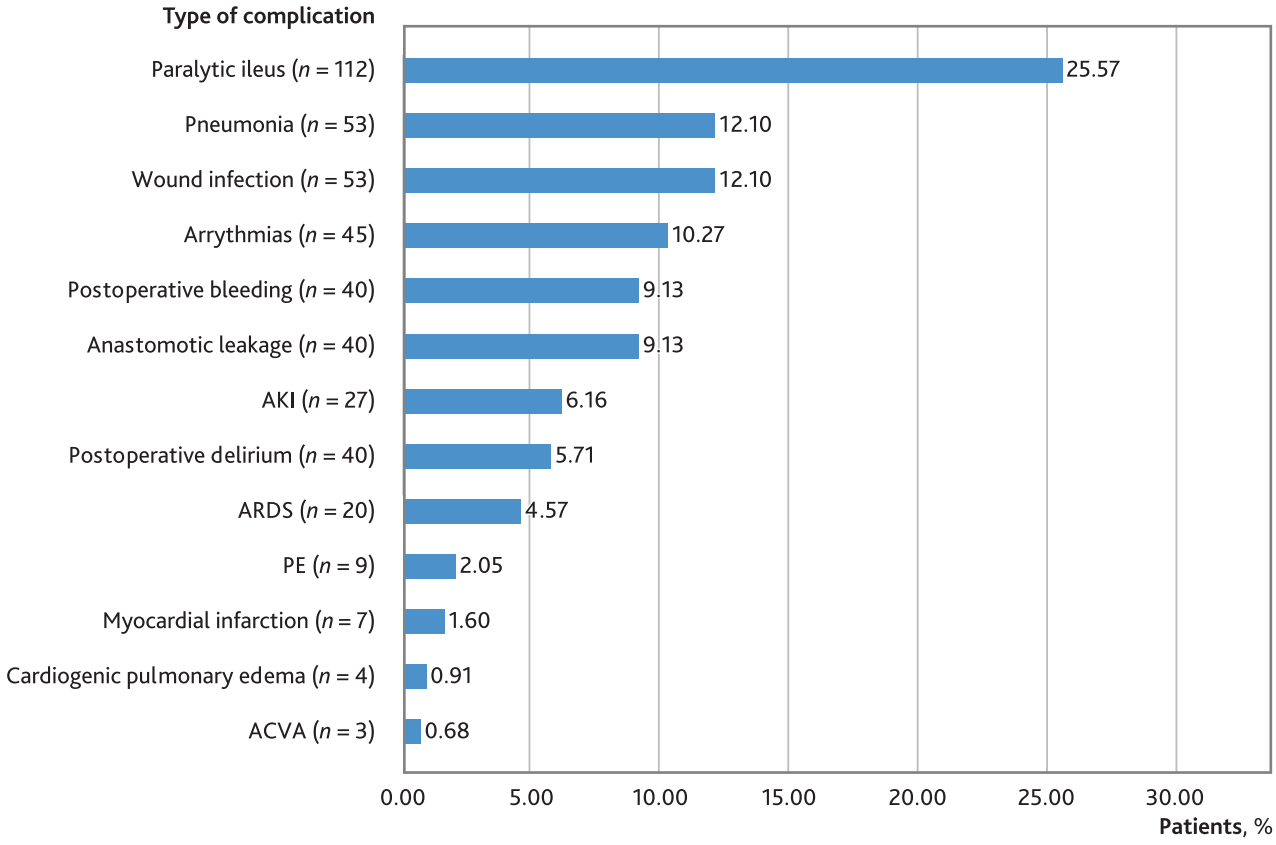

Fig. 4. Structure of complications

ACVA — acute cerebrovascular accident; AKI — acute kidney injury; ARDS — acute respiratory distress syndrome; PE — pulmonary embolism.

Table 2. Complication rate

Frequency of complications (*n* = 438)	*n*	%
Paralytic ileus	112	1.35
Pneumonia	53	0.60
Wound infection	53	0.60
Arrhythmias	45	0.50
Postoperative bleeding	40	0.48
Anastomotic leakage	40	0.48
AKI	27	0.30
Postoperative delirium	25	0.30
ARDS	20	0.24
PE	9	0.10
Myocardial infarction	7	0.08
Cardiogenic pulmonary edema	4	0.05
ACVA	3	0.03

ACVA — acute cerebrovascular accident; AKI — acute kidney injury; ARDS — acute respiratory distress syndrome; PE — pulmonary embolism.

syndrome (ARDS) and pulmonary embolism (PE) — 2–4%; myocardial infarction — 1.6%, and cardiogenic pulmonary edema and ACVA accounted for less than 1% (Figure 4). The complication rate was 1.3% for paralytic ileus, 0.6% for pneumonia, 0.6% for wound infection, 0.5% for arrhythmia, 0.46% for postoperative bleeding and anastomosis leakage; the frequency of AKI and postoperative delirium was 0.3%, ARDS — 0.2%; PE — 0.1% and less than 0.08% — for myocardial infarction (MI), cardiogenic pulmonary edema and ACVA (Table 2).

In patients with a single developed complication (211 patients), paralytic ileus, wound infection and pneumonia prevailed in the structure (Table 3).

Paralytic ileus and pneumonia, paralytic ileus and delirium, paralytic ileus and anastomotic leakage dominated in the structure of combined complications in patients with two complications (40 patients) (Table 4).

In patients with three or more complications (34 patients), the combinations of complications were equally distributed. The mortality rate was 61.7%. Twenty-one patients died.

Both mortality and complication rates increased with an increase in the number of concomitant diseases (Figure 5). In patients with 4 CD, the mortality rate was 1.5%, in patients with 1–3 CD it was 0.5–0.7% and in patients without any CD it was 0.16%. The effect of comorbidity on postoperative complications was as follows: it was 12% in patients with 4 CD, from 5.7% to 3.4% with the number of CD from three to one, and it did not exceed 1.3% in patients with no CD.

Table 5 shows the main combinations of concomitant diseases in deceased patients.

Discussion

By the time of this analysis, 8241 patients were included in the study with 12,000 patients declared in the protocol for the main cohort. A preliminary data analysis conducted in 2020 in 3002 patients [8] showed that 20% of all patients were classified as ASA Class I, 49 ASA Class II, 29 ASA Class III. To date, the general trend has remained the same: 18.4% were assigned to ASA Class I, 51.8% to ASA Class II, and 29.8% of patients were assigned to ASA Class III. In 2020, according to severity patients were distributed as follows: high-risk operations — 8%, intermediate — 55% and low-risk — 37%. Data from 2022 showed that the share of high-risk operations in the structure of surgical interventions increased to 10%, the share of intermediate-risk operations was 51%, and low-risk operations — 39%. In general, compared with extensive international studies that have studied the outcomes of surgical interventions in the world and in Europe, the proportion of high-risk operations is still significantly lower, and the structure of the initial physical status is comparable with other studies [9, 10], while the proportion of patients with severe concomitant diseases is even higher.

Table 3. Structure of complications in the group of patients with one complication (*n* = 211)

Complications	*n*	%	Lethality	
			n	%
Paralytic ileus	68	23.8	2	5.5
Wound infection	37	12.9	—	—
Pneumonia	23	8.0	1	2.7
Arrhythmias	23	8.0	—	—
Postoperative bleeding	20	7.0	1	2.7
Anastomotic leakage	13	4.5	—	—
Postoperative bleeding	9	3.1	—	—
AKI	9	3.1	1	2.7
PE	5	1.7	1	2.7
Myocardial infarction	2	0.7	1	2.7
ARDS	1	0.3	—	—
Cardiogenic pulmonary edema	1	0.3	—	—

ACVA — acute cerebrovascular accident; AKI — acute kidney injury; ARDS — acute respiratory distress syndrome; PE — pulmonary embolism.

Table 4. Structure of combinations of postoperative complications in patients with two complications (n = 40)

Complications	n	%	Lethality	
			n	%
Paralytic ileus + pneumonia	5	1.75	—	—
Paralytic ileus + delirium	4	1.40	—	—
Paralytic ileus + anastamotic leakage	4	1.40	—	—
AKI + PE	2	0.70	—	—
Bleeding + ARDS	2	0.70	1	2.7
Bleeding + PE	2	0.70	—	—
Paralytic ileus + bleeding	2	0.70	—	—
Anastomoticleakage + wound infection	2	0.70	—	—
Arrhythmia + paralytic ileus	2	0.70	—	—
Pneumonia + cardiogenic pulmonary edema	2	0.70	—	—
Paralytic ileus + wound infection	1	0.35	1	2.7
Delirium + pneumonia	1	0.35	—	—
Bleeding + myocardial infarction	1	0.35	1	2.7
Bleeding + wound infection	1	0.35	—	—
Anastomotic leakage + myocardial infarction	1	0.35	—	—
Paralytic ileus + AKI	1	0.35	—	—
ARDS + anastomotic leakage	1	0.35	—	—
Paralytic ileus + ARDS	1	0.35	—	—
Wound infection + pneumonia	1	0.35	—	—
Arrhythmia + delirium	1	0.35	—	—
Arrhythmia + ACVA	1	0.35	—	—
Paralytic ileus + arrhythmia	1	0.35	—	—
Pneumonia + arrhythmia	1	0.35	—	—

ACVA — acute cerebrovascular accident; AKI — acute kidney injury; ARDS — acute respiratory distress syndrome; PE — pulmonary embolism.

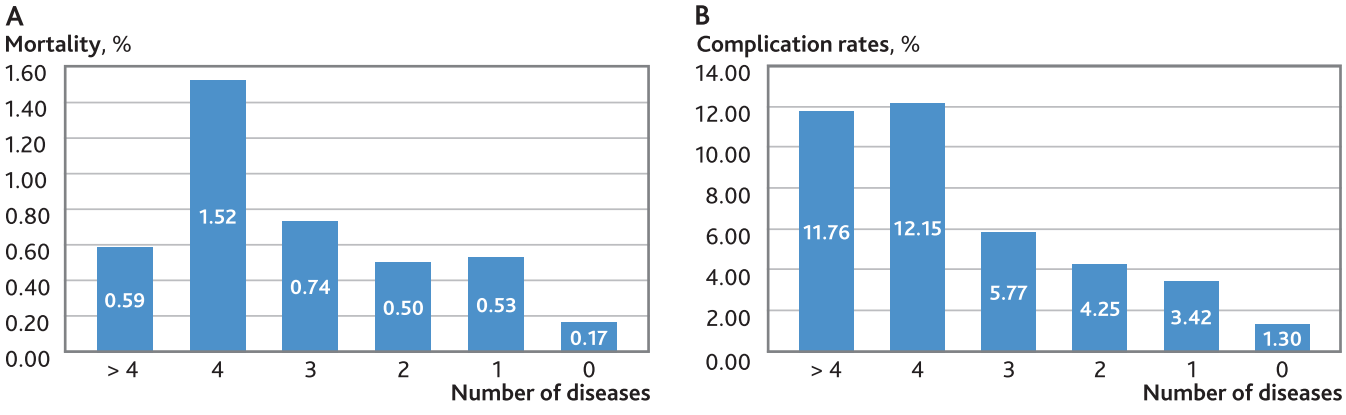

Fig. 5. Mortality (*A*) and complication rate (*B*) in patients with different number of concomitant diseases

Table 5. The structure of combinations of concomitant diseases in patients with a fatal outcome

Concomitant diseases and their combinations	*n*	% in the structure
AH	9	25.0
AH + CAD + CHF + arrythmia	4	11.1
AH + DM	2	5.5
AH + COPD	2	5.5
AH + CAD + CHF	2	5.5
COPD	1	2.8
AH + CHF	1	2.8
AH + arrythmia	1	2.8
AH + CHF + DM	1	2.8
AH + CHF + arrythmia	1	2.8
CAD + CHF + arrythmia	1	2.8
CFD + CHF	1	2.8
AH + CAD + COPD	1	2.8
CAD + CHF + ACVA + DM	1	2.8
AH + CAD + CHF + CKD + DM	1	2.8
AH + arrythmia + CKD + DM	1	2.8
No concomitant disease	6	16.6

ACVA — acute cerebrovascular accident; AH — arterial hypertension; CAD — coronary artery disease; CHF — chronic heart failure; CKD — chronic kidney disease; COPD — chronic obstructive pulmonary disease; DM — diabetes mellitus.

We have not found any large multicenter studies devoted to the study of outcomes directly in abdominal surgery. The structure of the initial physical status close to STOPRISK was demonstrated by an observational single-center study conducted in an Iceland hospital and devoted to the study of the outcomes of abdominal operations. The authors estimated the ratio of ASA grades 1, 2 and 3 as 28 %, 51 % and 21 % [11]. The structure of the severity of surgical interventions was also similar to the analyzed study. The number of operations of moderate severity and minor severity was comparable — 46.0 % and 46.4 %, and high-risk operations — only 7.6 %, which is even less than in the STOPRISK study. However, despite this, the percentage of mortality and complications was high — 1.8 % and 19.9 %, respectively, which may be a consequence of the inclusion of emergency operations in the analysis. Interestingly, the traumaticity of the operation turned out to be an independent predictor of the development of complications and 30-day mortality, in contrast to the number of complications and the comorbidity index, which once again confirms the fact that extrapolation of previously created comorbidity indices, as well as a simple addition of the number of complications, can hardly improve the quality of the prognosis, and an assessment of the contribution of each disease in a particular population is required.

Two large observational studies showed a different structure of physical status. The proportion of class I patients was only 8.4 % and 10.4 %, respectively, compared with 18.4 % in the STOPRISK study [1, 12].

Even though, in general, both mortality and complication rate were lower in the STOPRISK study compared to similar international studies such as ISOS [9], the tendency to increase the frequency of adverse outcome with increasing injury was observed in the national cohort. Thus, in the STOPRISK study, the mortality rate was 0.1 %, 0.3 % and 3.3 % in the low, medium and high-risk groups, respectively (compared with 0.2 %, 0.3 % and 0.9 % in the ISOS study), and the complication rate was 1.0 %, 3.3 % and 15.3 % in the low, medium and high-risk groups, respectively (compared to 8.0 %, 12.3 % and 26.8 % in the ISOS study).

Concomitant diseases occurred in more than half of all 55.5% of the patients included in the analysis. The main place in their structure was occupied by cardiovascular diseases, chronic heart failure, coronary heart disease, cardiac arrhythmias, as well as diabetes mellitus. The incidence of hypertension was 46.8%, which is comparable with the data of foreign studies on the incidence of AH in abdominal surgery. M. Kim et al. reported the incidence of 44.8% [1], C.M. Simões et al. showed 47.7% [13]. However, C.M. Simões et al. noted that the incidence of coronary heart disease was 6.5% and CHF — 8.1%, which is almost 3 times lower than the data obtained in STOPRISK. M. Kim et al. reported the incidence of CAD of 0.6%, without isolating CHF into an independent concomitant disease. On the contrary, the incidence of diabetes mellitus is significantly higher in foreign studies, it was 17.2% in the study of C.M. Simões et al. and 15.8% in the study of M. Kim et al., while according to STOPRISK, diabetes occurs in 9.4%. All other concomitant diseases occurred in less than 5% of patients: CKD, COPD, ACVA and others. It should be noted that the literature data on the frequency of occurrence of these diseases are contradictory. So, in the study of C.M. Simões et al., CKD was observed in every fifth patient, however, the work studied concomitant diseases in patients with oncological diseases, which could contribute to the structure of comorbidity. In the presence of two or more concomitant diseases, combinations of AH, CHF, coronary heart disease and diabetes mellitus were most common, which is not surprising, given their prevalence and pathogenetic relationship. Compared with the cross-section of the study carried out in 2020, the structure of concomitant diseases has changed little, except for an increased proportion of hypertension (from 14.2% to 46.8%), which is a consequence of changes in the protocol and full registration of the disease.

The presence of one or more complications was recorded in 285 patients (3.5%), fatal outcome — in 36 patients (0.43%). Thus, the mortality in the STOPRISK study is comparable to the mortality recorded in international observational studies [9], however, the incidence of postoperative complications was lower, both in general and for individual complications. So, the incidence of postoperative pneumonia was 0.6%, while in the study of J.N. Cohan et al. it was 1.0% [14]. M. Kim et al. showed that the incidence of pneumonia was 2.6% [1], and C.M. Simoes et al. showed 4.2% [13]. However, the frequency of myocardial infarction and PE in the STOPRISK database (0.08% and 0.05%, respectively) was comparable with the data obtained by J.N. Cohan et al., who studied the outcomes of surgical treatment in coloproctology (0.04% for both complications) [14]. Of course, the lethality and incidence of complications largely depend on the nature of the surgical intervention. Thus, the above-mentioned international multicenter ISOS study, which studied the outcomes of all non-cardiac operations, showed a wide variability in the frequency of adverse outcomes even within abdominal surgery from a mortality rate of 0.1% and a complication rate of 9.8% in operations on pelvic organs to mortality rate of 1.5% and complications of 24.3% in operations on the upper abdomen [9]. This fact makes it much more difficult to compare the frequency of outcomes in extensive population studies.

The low complication rate can partly be explained by a smaller number of high-risk operations, however, taking into account the fact that in the structure of the initial physical status of ASA, the proportion of patients with severe concomitant diseases is quite high, it is impossible to exclude an underestimation of the occurrence of some postoperative complications that are not taken into account by the ESA-ESICM classification [15], but are present in other classifications, such as the classification of ACS-NSQIP (National Program for Improving the Quality of Surgical Care of the American College of Surgeons) [16] or JOCG (Japanese Oncology Clinical Group) [17].

Naturally, the incidence of postoperative complications and mortality increased with the number of concomitant diseases, while the greatest increase in the frequency of adverse outcome was observed in the presence of more than 3 diseases.

E.D. Brynjarsdottir et al. showed in a single-center study in abdominal surgery that 70% of all patients had no concomitant diseases, 1 disease was noted in 23%, 2 in 6%, and only 1% of all patients had 3 or more concomitant diseases [11]. L.Gianotti et al. reported about 41.2% of patients without any concomitant diseases, 29.2% had with one, 20.8% had two and 8.8% had three or more diseases during planned extensive abdominal operations [18]. U.Skorus et al. (2020) notes that the number of patients without concomitant diseases is only 14.1% of all patients in abdominal surgery, and patients with three or more diseases is 39.2% [19], which is significantly higher than the data of previous researchers. At the same time, the subanalysis showed that the differences in the incidence of comorbid patients (> 3 diseases) do not differ in emergency and planned operations (41.48 versus 35.50, respectively), but logically depends on age (20 at the age of 65–74 years and 45% at the age of more than 74 years). Nevertheless, multivariate regression analysis showed that the number of complications is independently associated with an unfavorable outcome only in emergency operations (OR 1.22 (1.12–1.34) for 30-day mortality, and 1.14 (1.05–1.23)) for postoperative complications), and individual concomitant diseases are predictors of an unfavorable outcome in elective surgery. Thus, the number of complications and their prognostic role depend, among other things, on the cohort studied and approaches to the registration of concomitant diseases.

The role of comorbidity to the formation of perioperative risk has been studied for a long time; several tools have been proposed to assess the role of the comorbid

background and quantify the risk of complications. One of the most famous is the Charlson comorbidity index, developed in 1987 [20] and subsequently modified by the authors [21]. Unfortunately, a significant part of modern works did not find a reliable its predictive value in assessing the risk of postoperative complications [22–24]. Undoubtedly, this does not indicate that co-existing diseases have become less of a contributor to the risk of adverse outcomes, but rather that in the context of the development of medicine, the comorbid structure in the population is changing, treatment and the possibilities of perioperative therapy in modifying risk factors are changing, too. This is supported by the fact that current comorbidity-based predictive models, such as the Preoperative Score to Predict Postoperative Mortality (POSPOM) [25] and ACS-NSQIP [26], have an excellent predictive value. On the other hand, as practice shows, extrapolation of known, albeit well-functioning, scales to other populations can significantly reduce their prognostic capabilities, which dictates the need to study the national cohort of patients and develop a national scale for predicting postoperative complications. The structure of co-existing diseases largely depends on the population studied, as demonstrated in the ASOS study [27], which studied the outcomes of surgical treatment in African countries, where the three most common diseases were arterial hypertension (16 %), HIV infection (11 %) and diabetes (6.8 %). The reasons for such differences are varied and require a separate in-depth study.

Study limitations

The analysis revealed an uneven distribution of the severity of surgical interventions with a bias towards low-traumatic operations, which affects the frequency of the analyzed outcomes and can lead to a distorted understanding of the patterns that exist in the population.

A significant proportion of patients were enrolled in the study during the COVID-19 pandemic, which affected the dynamics of patient recruitment and, possibly, the structure of surgical interventions and co-existing diseases. The fact of the transferred coronavirus infection was not analyzed.

Conclusion

Co-existing diseases occurs in more than half of patients undergoing abdominal surgery, with the most common diseases being arterial hypertension, chronic heart failure, coronary artery disease, diabetes mellitus, and cardiac arrhythmias. The incidence of most comorbidities (except for arterial hypertension and stroke) differed from similar foreign studies.

The postoperative complication rate was 3.5 %, mortality was 0.43 %, with postoperative paralytic ileus, wound infection, and pneumonia being the most common. The frequency of individual postoperative complications was 2–5 times lower than in foreign publications. A possible reason for the significantly lower number of postoperative complications was a decrease in the proportion of highly traumatic operations (by 2.5–3.5 times) and an increase in the proportion of low-traumatic interventions (by 1.5–2 times). With an increase in the number of co-existing diseases, the risk of an adverse outcome increases.

Disclosure. I.B. Zabolotskikh — First Vice-President, A.I. Gritsan — Vice President, K.M. Lebedinskii is the President of the all-Russian public organization "Federation of anesthesiologists and reanimatologists". Other authors declare that they have no competing interests.

Author contribution. All authors according to the ICMJE criteria participated in the development of the concept of the article, obtaining and analyzing factual data, writing and editing the text of the article, checking and approving the text of the article.

Ethics approval. This study was approved by the local Ethical Committee of Kuban State Medical University, Krasnodar, Russia (reference number: 78-24.05.2019).

Funding source. This study was not supported by any external sources of funding.

Data Availability Statement. The data that support the findings of this study are openly available in repository Mendeley Data at http://doi.org/10.17632/p6zr5s26yg.1

Registration of the study. The study was registered in the international database https://clinicaltrials.gov under the auspices of the All-Russian Public Organization "Federation of Anesthesiologists and Reanimatologists" (principal investigator I.B. Zabolotskikh), study number NCT03945968.

Author's ORCID:

Zabolotskikh I.B. — 0000-0002-3623-2546
Trembach N.V. — 0000-0002-0061-0496
Magomedov M.A. — 0000-0002-1972-7336
Popov A.S. — 0000-0003-2241-8144
Malyshev Yu.P. — 0000-0002-4191-4496
Dmitriev A.A. — 0000-0002-5195-3149
Grigoryev E.V. — 0000-0001-8370-3083
Fisher V.V. — 0000-0003-1494-1613
Khoronenko V.E. — 0000-0001-8845-9913
Kokhno V.N. — 0000-0002-5965-2594

Spasova A.P. — 0000-0002-2797-4740
Davydova V.R. — 0000-0003-4718-5076
Gritsan A.I. — 0000-0002-0500-2887
Lebedinskii K.M. — 0000-0002-5752-4812
Dunts P.V. — 0000-0001-6950-2947
Bayalieva A.Zh. — 0000-0001-7577-3284
Ovezov A.M. — 0000-0001-7629-6280
Martynov D.V. — 0000-0003-3644-5274
Arikan N.G. — 0000-0002-8731-6168
Kirov M.Yu. — 0000-0002-4375-3374
Ershov V.I. — 0000-0001-9150-0382
Pasechnik I.N. — 0000-0002-8121-4160
Kuzovlev A.N. — 0000-0002-5930-0118
Fedunets D.E. — 0000-0002-3285-0603

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