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Influence of the Covid-19 pandemic on hospital stay after knee and hip arthroplasty

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Abstract

Introduction The Covid-19 pandemic has led to quite significant changes in the length of hospital stay of orthopedic patients. Meanwhile, there has been a tendency for early discharge after arthroplasty for quite some time due to the increasing burden on health care systems that became possible due to the implementation of accelerated rehabilitation protocols. This study is dedicated to the effect of discharge terms on the incidence of postoperative complications. **Material and methods** A retrospective study of 1,837 patients who underwent primary/revision THA and TKA at our center in 2020 was carried out. The impact of the pandemic was assessed by comparing the duration of hospitalization, the incidence of complications and functional status in patients operated on before and after the introduction of epidemiological restrictions. **Purpose** of the study To assess the impact of the Covid-19 pandemic on the length of patients' hospital stay after knee and hip arthroplasty. **Results** The total duration of hospitalization after primary THA was reduced by 35 % (from 11.8 ± 3.3 to 7.7 ± 2.6 bed-days), and by 38 % (from 19.9 ± 7.5 to 12.8 ± 6.3 bed-days) after revision THA. The overall readmission rate (for surgical and nonsurgical complications) after primary THA was 4.1 % before the pandemic and 4.3 % during the pandemic; for primary TKA it was 2.1 % and 5.1 %, respectively; for revision THA – 13.9 % and 4.5 %, revision TKA – 4.4 % and 9.8 %, respectively. Comparative assessment for each diagnosis separately did not show significant difference. Evaluation of the questionnaire survey using the Oxford hip/knee score also showed the absence of a statistically significant relationship between the time of discharge and the functional state of the operated joint. The interviewing of patients regarding the infection with coronavirus yielded positive answers in 22 % (n = 419). The onset of symptoms during hospitalization or within 14 days after discharge was noted by 4 % of respondents (n = 75). **Conclusion** The incidence of complications and unfavorable outcomes did not depend on the length of hospital stay after THA and TKA.

Keywords: Covid-19 pandemic, arthroplasty, knee joint, hip joint, hospitalization

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INTRODUCTION

The COVID-19 pandemic has led to unprecedented restrictions aimed at containing the pandemic, thereby affecting all aspects of society's life. The most striking changes, of course, are in the health care system. In many countries, during the peak of the first wave of the pandemic (March, April 2020), planned operations were suspended due to the re-profiling of hospitals, as well as to protect patients and staff from asymptomatic and undiagnosed carriers [1, 2]. The performance of orthopedic interventions has significantly decreased [3, 4]. In June 2020, the need to restore the planned service led to the resumption of the work of specialized institutions. However, the everyday work of surgical departments has changed significantly [5, 6]. The imposed sanitary and epidemiological restrictions in hospitals could not properly prevent the spread of viral pneumonia, and led to the need to reduce the duration of patients' stay in hospitals [7, 8].

However, for a long time there has been a tendency abroad towards early discharge of patients after orthopedic interventions, that has been largely caused by an increasing burden on health care systems, hospitals and doctors and, as a consequence, the need to reduce financial costs of treatment. According to C.J. Lavernia et al., the total US hospital expenditures on hip and knee arthroplasty in 2015 was $ 65 billion [9]. In Germany, arthroplasty of the hip and knee joints are the two most frequently performed surgeries with a total cost of 1.4–1.6 and 1.0–1.3 billion euros, respectively (according to the reported data of the state medical insurance system for 2003–2009) [ten]. However, the desire to reduce treatment costs due to early discharge should be confirmed by the evidence of absent complications and no less proven by the effectiveness of the intervention performed. J. Spence et al. we studied the mortality rate from postoperative complications in a prospective randomized study of 40,004 patients who underwent emergency and elective interventions in 28 hospitals from 14 countries. The results of the study showed that out of 715 deaths five (0.7 %) occurred during the operation, 500 (69.9 %) from the moment of the intervention to discharge, and 210 (29.4 %) after discharge [11]. Therefore, there are logical fears that a reduction in the length of hospital stay may lead to a proportionally higher rate of out-of-hospital complications, an increase in morbidity and mortality.

In clinical studies, the assessment of the effect of hospitalization terms for orthopedic patients on complications arising in the postoperative period is based on an indicator characterizing the rate of re-hospitalizations within a 30- and 90-day period after discharge or all-cause readmission rate. This indicator includes not only complications arising in the area of surgical intervention, but also systemic complications that can also be caused by the treatment, for example, deep vein thrombosis, pulmonary embolism, anemia, gastrointestinal bleeding, etc. Statistically significant results of such studies require large patient samples such

as registry data. A recent large study included 333,212 patients from 700 hospitals who underwent arthroplasty of the knee and hip joints (data from the register of the National Program for the Improvement of the Quality of Surgery in the United States and Canada). The authors conducted a comparative assessment of complications and readmissions over a 30-day period in 3 groups, depending on the terms of discharge: standard (2–3 days from the date of arthroplasty), accelerated (the next day after TJA) and discharge on the day of the intervention. There were no statistically significant differences in all three groups, thus the authors concluded that early discharge does not increase the risk of postoperative complications. [12]. It should be noted that such a short discharge time, promoted by leading clinics in the USA and Europe, is possible thanks to accelerated rehabilitation protocols, including preoperative patient information, refusal of sedation therapy, adequate anesthetic management with control of postoperative pain syndrome and hemostasis, minimization of side effects, sparing surgical technique, and the earliest possible activation of the patient [13, 14]. In the domestic literature, there are publications reporting on the results of the implementation of these treatment protocols in the planned hip arthroplasty and knee joint replacement [15, 16]. However, no work has been carried out so far in Russia that evaluates the effect of discharge time on the incidence of postoperative complications and re-hospitalizations using a large clinical material. This fact served as a prerequisite for our study.

Purpose of the study: to assess the impact of the Covid-19 pandemic on the hospitalization period of patients after knee and hip arthroplasty.

Hypothesis: reducing the time spent by patients in the hospital would not lead to a proportional increase in surgical and non-surgical complications.

Key questions of the study:

How has the Covid-19 pandemic influenced the length of hospital stay? Does the timing of discharge of patients with planned hip and knee arthroplasty have an impact on the incidence of early complications? How many patients among the study participants had Covid-19, including while being in hospital and within 14 days after discharge?

MATERIAL AND METHODS

Our retrospective single-center study included all patients who underwent primary/revision hip and knee arthroplasties at our center in 2020. As part of this study, we conducted a survey among the patients to find out the complications that occurred after discharge from the hospital and readmissions for medical assistance.

Inclusion criteria: patients who answered the questionnaire developed by us.

Exclusion criteria:

• Incorrect patient's data for interviewing and analyzing complications (incorrect phone number, no information about the patient's diagnosis, volume of intervention);

• cases of repeated and incorrect filling of the questionnaire;

• patients who were in quarantine in April 2020 and had an extremely long duration of hospital stay; therefore, they were excluded from the comparative assessment of hospital stay and impact on postoperative complications.

Design of questionnaire

We have compiled two questionnaires in the service for creating electronic tests "Yandex Forms" for patients who underwent arthroplasty of the knee and hip joints, respectively. Each of the questionnaires consisted of two sections. The questions in the first section were identical in both questionnaires and focused on adverse outcomes associated with the prosthetic joint (surgical complications) and unrelated outcomes that could nevertheless be caused by the treatment (non-surgical complications). If the answer was yes, questions would automatically pop up regarding the patient's method of seeking medical help and the date of onset of symptoms (Fig. 1). In addition, in the first section of the questionnaire, there were questions regarding the history of Covid-19 infection, the date of manifestation of this disease, the method of confirming the diagnosis and the conditions of medical care (outpatient, inpatient).

The second section of the questionnaires contained 12 questions of the Oxford score system for assessing the function of the joint (Oxford hip score and Oxford knee score, respectively). Russian-language versions of these questionnaires have previously undergone cross-cultural adaptation and have proven their validity and internal consistency [17, 18]. Each question has one of five answer variants and is evaluated by a score from 0 to 4 points, the maximum possible total is 48 points.

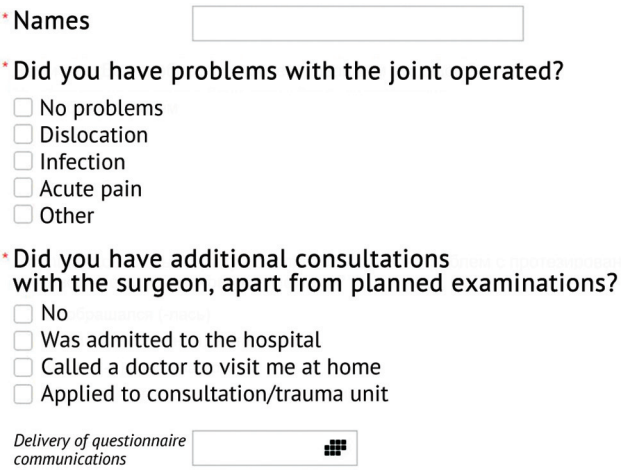

Fig. 1 Example of a questionnaire in the Yandex Forms service for patients that underwent operations

The center's database contains information on 6,574 patients who underwent primary/revision hip and knee arthroplasty from January 9 to December 21, 2020. Patient data were downloaded from the medical information system to the MS Excel table: surname, name, patronymic name, date of birth, contact phone number, department, date of admission, date of

operation, date of discharge, volume of intervention. Then, through the WhatsApp messenger a message was sent to each patient with a request to follow the link and answer the questions of the online questionnaire by creating an automatic hyperlink with the text of the message using the "WhatsApp open lines" protocol. We sent a repeated message to non-responding patients with a request to undertake the survey. The responses received in the Yandex Forms service were uploaded into a separate MS Excel spreadsheet for further analysis. Patients who stated complications or existing problems in the questionnaire were interviewed by phone by their attending physicians to find out the nature of the symptoms, the date of deterioration and possible re-admission.

Analysis of the results obtained

The total number of respondents was divided into two groups: those who underwent operations from January 9 to March 31 (period 1) and from May 1 to December 21, 2020 (period 2). The division into time intervals was due to the temporary suspension of planned operations in April 2020 and the subsequent introduction of sanitary and epidemiological restrictions due to the spread of the coronavirus infection. An impact of the Covid-19 pandemic on the duration of hospitalization was assessed by comparing, in the mentioned periods, the average number of inpatient days spent in the hospital before surgery, from the moment of the intervention performed to discharge and the total time spent in the hospital.

Further, a comparative assessment of the incidence of surgical and nonsurgical complications that occurred within 90 days after performing primary and revision arthroplasty in the patients in the 1st and 2nd periods was performed. Also, we estimated the mean values according to the Oxford hip/knee score depending on the number of bed-days spent after surgery.

Statistical processing

The material obtained was statistically processed using the methods of parametric and nonparametric analysis. The accumulation, correction, systematization of the initial information and visualization of the results were carried out in Microsoft Office Excel 2010. Statistical analysis was carried out using the IBM SPSS Statistics v.23 program (developed by IBM Corporation). Aggregates of quantitative indicators, the distribution of which differed from normal, were described using the values of the median (Me), the lower and upper quartiles (Q1–Q3). Nominal data were described with absolute values and percentages.

The Mann-Whitney U-test was used to compare independent populations. Comparison of nominal data was carried out using the Pearson χ^2 test with Yates' correction (with the expected occurrence in at least one cell less than 10), which enables to assess the significance of the differences between the actual number of outcomes and the theoretical number that can be expected in the studied groups if the null hypothesis is valid. In order to study the relationship between the phenomena represented by quantitative data, the distribution of which differed from the normal one, a nonparametric method was used, the calculation of the Spearman's rank correlation coefficient.

RESULTS

Among 6,574 patients who underwent arthroplasties in 2020, messages were received by 3,769. Connection failed in 2805 cases. The possible reasons include the absence of the WhatsApp application on the patient's phone, as well as an incorrect contact number. 1405 patients responded within 7 days. After the repeated mailing, the total number of respondents was 1837, 1366 women (74 %) and 471 men (26 %) (Table 1). The average age of the patients was 60.9 years (range, 21 to 93), and the average follow-up period was 5.8 months (range, 3 to 12). 741 patients underwent primary and revision arthroplasty of the hip joint, and 1096 of the knee. 17 patients underwent re-operations due to complications, thus, the total number of operations was 1854 (Fig. 2).

The average duration of hospitalization from the moment of admission to discharge in the first period was 12.6 ± 4.6 bed-days, and 8.3 ± 3.8 bed-days in the second period (Table 2). The average duration of postoperative hospitalization in the first period was 8.5 ± 3.2 bed-days, in the second – 5.6 ± 2.5 bed-days.

Among the patients who underwent primary TJAP, the total hospitalization period in the first period averaged 11.8 ± 3.3 bed-days, and 7.7 ± 2.6 bed-days in the second period; the period of postoperative hospitalization was 8.1 ± 2.3 and 5.3 ± 1.8 bed-days, respectively. In the revision arthroplasty group, the total duration of hospital stay averaged 19.9 ± 7.5 bed-days in the first period and 12.8 ± 6.3 bed-days in the second, and after the operation 12.4 ± 6. 2 and 7.6 ± 4.5 bed-days, respectively.

Thus, the sanitary and epidemiological restrictions imposed due to the threat of the spread of viral pneumonia led to a 35 % reduction in the duration of patients' stay after primary TJA, and by 38 % after revision TJA.

Table 1

Sex and age characteristics of patients included in the study

	Total sample	Confirmed communication message	Respondents
Number of patients	6574	3769	1837
Males	1776 (27 %)	1402 (37 %)	471 (26 %)
Females	4798 (73 %)	2367 (63 %)	1366 (74 %)
Mean age, years	63,4 (19–94)	61,8 (20–93)	60,9 (21–93)
Me (25 %; 75 %)	65 (58; 71)	63 (56; 69)	62 (56; 69)

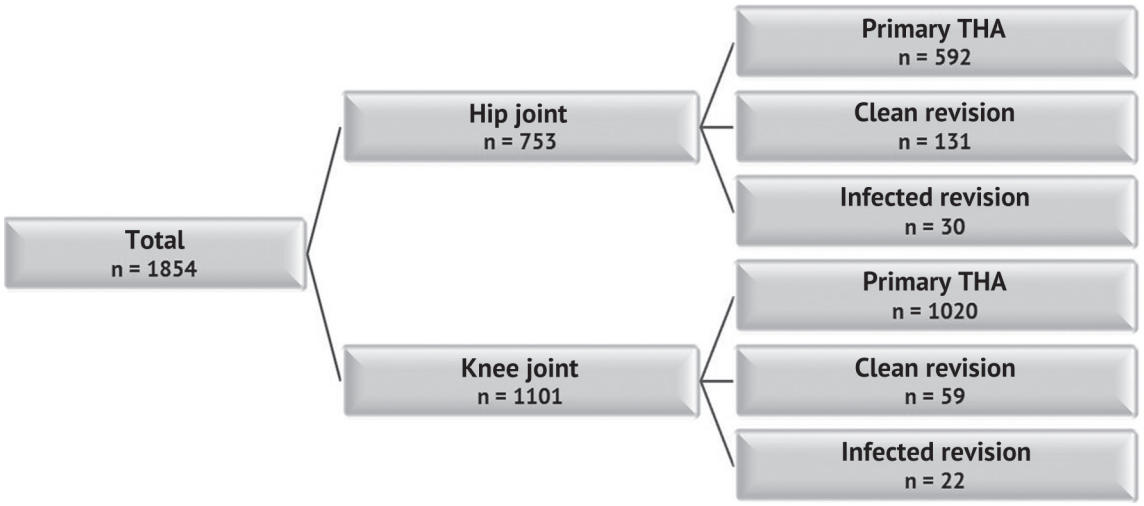

Fig. 2 Characteristics of the interventions

Table 2

Length of hospital stay before pandemic (January to March 2020) and during the pandemic (May-December 2020)

	Period 1 (n = 544)			Period 2 (n = 1250)		
	Before surgery	After surgery	Total	Before surgery	After surgery	Total
Average number of bed-days	4.1	8.5	12.6	2.7	5.6	8.3
Standard deviation	3.0	3.2	4.6	2.4	2.5	3.8
Me (25 %; 75 %)	3 (2; 6)	7 (7; 9)	12 (9; 14)	2 (1; 4)	5 (4; 6)	7 (6; 9)

In the group of patients who underwent primary arthroplasty of the hip joint, the incidence of surgical complications within 90 days after discharge was 0.8 % before the pandemic and 1.5 % during the pandemic (p = 0.567), the incidence of nonsurgical complications was 3.3 % and 2.8 %, respectively (p = 0.767) (Table 3). In the group of patients who underwent primary arthroplasty of the knee joint, the incidence of surgical complications was 0.5 % and 0.8 % (p = 0.633), and of non-surgical complications 1.6 % and 4.3 %, respectively (p = 0.034). At the same time, despite the significant difference in the total number of nonsurgical conditions, the comparative assessment for each diagnosis separately did not show significant difference.

In the revision arthroplasty group, the incidence of surgical complications in the 1st and 2nd periods was 10.4 % and 2.7 % (p = 0.192), the incidence of nonsurgical complications was 3.5 % and 1.8 %, respectively (p = 0.866) (Table 4). Among patients who underwent revision TKA, the incidence of surgical complications was 4.4 % and 3.9 %, the incidence of non-surgical complications was 0 % and 5.9 %, respectively (p = 0.582).

Table 3

Patient referrals due to surgical and nonsurgical complications within 90 days after primary arthroplasty

	THA			TKA		
	Period 1 (n = 120)	Period 2 (n = 461)	p	Period 1 (n = 372)	Period 2 (n = 626)	p
Surgical complications	1 (0.8 %)	7 (1.5 %)	0.894	2 (0.5 %)	5 (0.8 %)	0.932
Dislocation	–	2 (0.4 %)	0.880	–	–	
Infection	–	2 (0.4 %)	0.880	1 (0.3 %)	4 (0.6 %)	0.736
Hematoma	–	1 (0.2 %)	0.469	–	1 (0.2 %)	0.793
Periprosthetic fracture	1 (0.8 %)	2 (0.4 %)	0.865	1 (0.3 %)	–	0.793
Nonsurgical complications	4 (3.3 %)	13 (2.8 %)	0.995	6 (1.6 %)	27 (4.3 %)	0.034
Deep vein thrombosis	1 (0.8 %)	2 (0.4 %)	0.865	1 (0.3 %)	3 (0.5 %)	0.993
Anemia	1 (0.8 %)	5 (1.1 %)	0.792	–	6 (1.0 %)	0.142
Arrhythmia	–	1 (0.2 %)	0.469	2 (0.5 %)	4 (0.6 %)	0.824
Acute brain circulation disorder	–	1 (0.2 %)	0.469	–	1 (0.2 %)	0.793
Infarction	1 (0.8 %)	–	0.469	–	–	–
Hypertensive crisis	1 (0.8 %)	1 (0.2 %)	0.880	2 (0.5 %)	6 (1.0 %)	0.724
Digestive system bleedings	–	–	–	–	1 (0.2 %)	0.793
Urinary tract infection	–	1 (0.2 %)	0.469	1 (0.3 %)	2 (0.3 %)	0.649
Renal colic	–	1 (0.2 %)	0.469	–	1 (0.2 %)	0.793
Depression	–	1 (0.2 %)	0.469	–	3 (0.5 %)	0.460

Table 4

Patient referrals due to surgical and nonsurgical complications within 90 days after revision arthroplasty

	THA			TKA		
	Period 1 (n = 29)	Period 2 (n = 112)	p	Period 1 (n = 23)	Period 2 (n = 51)	p
Surgical complications	3 (10.4 %)	3 (2.7 %)	0.192	1 (4.4 %)	2 (3.9 %)	0.851
Dislocation	–	–	–	–	–	
Infection	1 (3.5 %)	2 (1.8 %)	0.876	1 (4.4 %)	2 (3.9 %)	0.582
Hematoma		–	0.465	–	–	
Periprosthetic fracture	–	1 (0.9 %)	0.465	–	–	
Neuropathy	1 (3.5 %)	–	0.465	–	–	
Aseptic loosening	1 (3.5 %)	–	0.465	–	–	
Nonsurgical complications	1 (3.5 %)	2 (1.8 %)	0.866	0	3 (5.9 %)	0.582
Anemia	–	1 (0.9 %)	0.465	–	2 (3.9 %)	0.851
Acute brain circulation disorder	–	–		–	1 (2.0 %)	0.681
Stomach ulcer	1 (3.5 %)	1 (0.9 %)	0.876	–	–	

Evaluation of the effect of the discharge period after primary arthroplasty on the function of the operated hip joint, expressed in the mean values of the Oxford hip score questionnaire, showed higher rates in patients discharged 8–9 days after surgery, compared with 3–5 days. However, no statistically significant correlation was found (rs = -0.02). For patients after TKA, the Oxford knee scores did not correlate with the timing of discharge (rs = 0.03) either (Fig. 3).

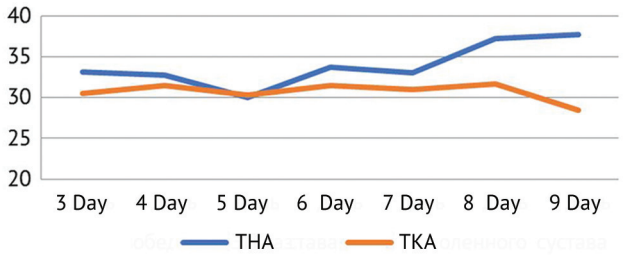

Fig. 3 Average Oxford hip/knee score in patients after primary arthroplasty, depending on the time of discharge from the moment of the intervention

Interviewing the operated patients regarding the previous coronavirus infection showed that 22 % of the respondents (n = 419) gave positive answers and indicated one or more ways to confirm the diagnosis. Among them, 8 % of those who had recovered (n = 144) were treated in a specialized hospital. These statistics indicate a rather high rate of moderate and severe forms of the disease (Fig. 4, 5). Among the patients who recovered from Covid-19, a separate subgroup of 75 patients (4 %) was identified who noted the onset of symptoms during hospitalization and within 14 days after discharge (Fig. 6), which corresponds to the incubation period of the SARS-Cov virus-2 [19].

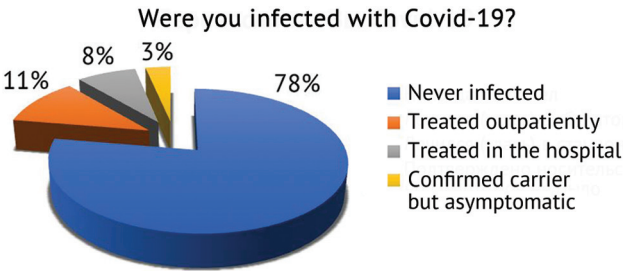

Fig. 4 Results of a survey of 1838 patients about the coronavirus infection. This question allowed only one possible answer.

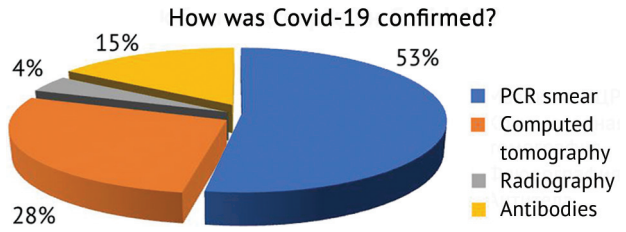

Fig. 5 Results of a survey of 419 patients who confirmed the coronavirus infection. Since the question allowed several possible answers, 148 respondents stated more than one answer. These answers were divided into corresponding graphs

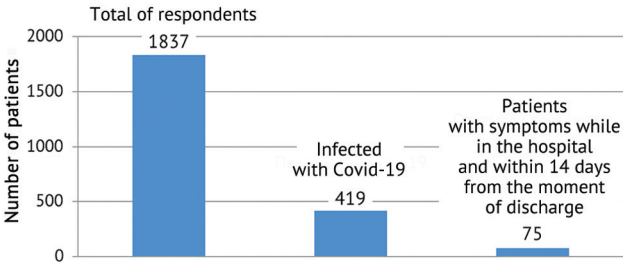

Fig. 6 Number of patients infected with Covid-19, in relation to all patients included in the study. A subgroup of 75 patients who noted the onset of symptoms while in the hospital and within 14 days from the moment of discharge stands separately

DISCUSSION

Knee joint and hip joint arthroplasties are among the most frequent surgical procedures in many countries. Thus, there were 237 TKAs and 167 THAs per 100,000 of the population in the United States in 2017, and their total number exceeded one million. By 2030, a total of four million operations has been predicted [21]. In Sweden, 332 patients per 100,000 population in the age group over 40 years underwent hip replacement in 2010, and by 2030 the increase in the number has been expected to reach 784 [22]. The National Register of England and Wales for 2019 reported about 102,497 completed primary and revision THAs and

110,325 TKAs [23]. In Russia, according to the Priorov CITO 62,194 hip joint replacements and 36,843 TKAs were performed in 2014 [24], but in 2018 the numbers increased to 72,270 and 47,945, respectively [25]. The data presented indicate a big growth in the number of total arthroplasty performed on large joints. Due to the increasing pressure on healthcare systems, the issue of reducing the inpatient time after arthroplasty operation was relevant even before the pandemic.

If in the 70s of the 20th century the duration of hospitalization after arthroplasty was at least 20 days [26], today, thanks to the accelerated rehabilitation programs introduced in many European countries, the discharge time in uncomplicated cases does not exceed 2–3 days, and in some clinics, TJA is an outpatient procedure [27, 28]. Husted et al. analyzed data from the Danish National Register and observed a decrease in the median term of discharge after arthroplasty from 10–11 days in 2000 to 4 days in 2009 [29]. Later data from the same register were assessed by P.B. Petersen et al. According to the authors, the median time of discharge decreased from three to one day from 2010 to 2017. At the same time, the frequency of repeated hospitalizations of patients within 90 days over a given period of time remained practically unchanged, about 8 % [30]. A retrospective study by P.A. Kirkland et al. included 172,760 patients who underwent knee joint and hip arthroplasty in the state of South Carolina in the United States from 2000 to 2015 and showed a decrease in the average hospital stay over the past 15 years from 4.6 to 2.7 days, but the rate of repeated visits of patients during the 90-day period decreased slightly, from 7.4 % to 7.0 % [31].

According to our study, the median of the total duration of the patients' stay during the pandemic decreased from 12 to 7 days, and the postoperative stay from 7 to 5 days. At the same time, the total rate of re-admissions (for surgical and nonsurgical complications) after primary THA was 4.1 % before the pandemic and 4.3 % during the pandemic, and 2.1 % and 5.1 % for TKA, respectively; after revision THA – 13.9 % and 4.5 %, and TKA revision 4.4 % and 9.8 %, respectively. Despite the visible differences in the total values, the statistical analysis for each individual diagnosis did not reveal significant differences in the periods. Evaluation of the results of the questionnaire survey using the Oxford hip/knee score did not show a statistically significant relationship between the time of discharge and the functional state of the involved joint either. Obviously, the discharge time varied in different groups of patients and was longer in more complex cases, but in general, the average postoperative bed-day decreased from 8.5 to 5.6 days.

In Russia, before the Covid-19 pandemic, due to the lack of economic prerequisites, the issue of reducing the length of stay of patients after orthopedic interventions was not as relevant as it is now. The results of our study confirmed the formulated hypothesis. In uncomplicated cases, discharge on the 4–5th day after arthroplasty does not increase the risk of repeated hospitalizations for both surgical and non-surgical complications. The reduction in hospitalization time for patients at our center was not driven by economic considerations, but by the desire to distance patients from the possible impact of Covid-19. I was a forced measure, but the encouraging results obtained lead to the idea of the need for further work to reduce the length of stay. To implement this work, it is necessary to determine the patient groups, routing and the order of further follow-up.

Undoubtedly, the decision on the duration of hospitalization of a patient must be taken by the attending surgeon based on age, body mass index, the severity of concomitant pathology, the severity of the operation, the dynamics of wound healing, the volume of postoperative hematoma and other factors. Establishing rigorous early discharge selection protocols will provide high-quality clinical outcomes while limiting complications and unnecessary risks. A necessary condition is also the development of a system of patronage and rehabilitation of patients after both primary and revision arthroplasty. Additional budgets for rehabilitation programs may significantly increase the involvement of health resort institutions in the process of patient recovery after large joint replacement and might be supervised by medical personnel. This, on the one hand, would improve the quality of care with a decrease in the risk of adverse events in the postoperative period, and on the other hand, it would free up an expensive surgical bed, what potentially increases the availability of specialized and high-tech medical care.

An innovative approach undertaken by this study to collection of survey results deserves special attention. It is the use of messengers for sending notifications with the possibility of online patient surveys. This way significantly reduces the labor costs for collecting both early and medium-term results and increases the objectivity of the data, since this process takes place without the influence of the attending doctor.

CONCLUSIONS

1. The Covid-19 pandemic has led to a 35 % reduction in the average length of hospital stay for patients with primary TJA (from 11.8 to 7.7 bed-days), and by 38 % (from 19.9 to 12.8 bed-days) with revision TJA.

2. Comparative analysis of the frequency of repeated referrals of patients operated on before and after the introduction of sanitary and epidemiological restrictions showed the absence of significant differences in the periods. Evaluation of the results of the Oxford hip/ knee score questionnaires also did not reveal a significant relationship between the time of discharge and the functional state of the replaced joint. Thus, the adverse outcomes observed in the early period after arthroplasty did not depend on the term of patients' discharge.

3. Interviewing of patients showed positive answers regarding the coronavirus infection in 22 % (n = 419), but only 4 % of respondents (n = 75) noted the onset of symptoms during hospitalization or within 14 days after discharge.

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