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Predictors for Recurrence of Chronic Osteomyelitis Following Long Bones Cavity Defect Replacement with Synthetic Materials

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Abstract

Background. To date, there is a lack of studies in modern scientific literature that would highlight the factors affecting the development of recurrent infection after surgical treatment of chronic osteomyelitis.
The aims of the study: 1) to identify significant risk factors for infection recurrence in one- and two-stage cavity defect replacement with synthetic materials in patients with chronic osteomyelitis; 2) based on the findings, to develop a surgical treatment algorithm for this patient population.
Methods. The study enrolled 131 patients with chronic osteomyelitis of long bones. Based on the treatment outcome, the patients were divided into two groups: Group 1 (n = 90) – successful suppression of the infection; Group 2 (n = 41) – recurrent osteomyelitis after one- or during two-stage treatment. Differences between the groups were assessed to identify the factors that affect the recurrence risk. We conducted a multifactorial analysis using classification trees to develop a scale for Comprehensive Osteomyelitis Recurrence Risk Assessment (CORRA).
Results. The following factors affecting the treatment outcome were assessed: localization (r = 0.205, p = 0.019); duration of osteomyelitis (r = 0.23, p = 0.007); presence of debridement operations in the medical history (r = 0.264, p = 0.002); volume of the bone defect (r = 0.175, p = 0.045); anatomical type (r = 0.15, p = 0.086) and physiological class (r = 0.188, p = 0.004) according to the Cierny-Mader classification; nature of the pathogen (r = 0.123, p = 0.162). We determined the risk degree for osteomyelitis recurrence, as well as threshold values for quantitative indicators and the total score on the CORRA. In patients with a score greater than 5 on the CORRA during one-stage treatment, the risk of osteomyelitis recurrence increased 8.1 times compared to patients with a score of 5 or fewer (OR = 8.143; CI 1.008-65.882). In two-stage treatment, patients with a score greater than 5 on the CORRA had a 4.1 times increased risk of osteomyelitis recurrence compared to patients with 5 points or fewer (OR = 4.059, CI 0.461-35.714). Based on the CORRA scale, we developed an algorithm for choosing a treatment strategy for these patients.
Conclusions. Significant risk factors for recurrence of infection are: localization, duration of osteomyelitis, presence of debridement operations in the medical history, volume of the bone defect, nature of the pathogen, anatomical type and physiological class according to the Cierny-Mader classification. The developed scale for comprehensive osteomyelitis recurrence risk assessment based on the factors can help to predict the infection recurrence and choose correct surgical treatment approach.

Keywords: osteomyelitis of long bones, risk factors for recurrence, cavity bone defect.

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Предикторы рецидива хронического остеомиелита при заполнении полостных дефектов длинных костей синтетическими материалами

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Реферат

Актуальность. В современной научной литературе до сих пор мало публикаций, в которых освещены факторы, влияющие на развитие рецидива инфекции после хирургического лечения хронического остеомиелита.

Цели исследования — определить значимые факторы риска развития рецидива инфекции при одно- и двухэтапном замещении полостного дефекта синтетическими материалами у пациентов с хроническим остеомиелитом и на основании полученных данных разработать алгоритм хирургического лечения профильных пациентов.

Материал и методы. В исследование включен 131 пациент с хроническим остеомиелитом длинных костей конечностей. В зависимости от результата лечения больные разделены на две группы: группа 1 (n = 90) — с успешным купированием инфекционного процесса; группа 2 (n = 41) — с развитием рецидива остеомиелита после одноэтапного или в ходе двухэтапного лечения. Оценивали различия между группами для выявления факторов, влияющих на развитие рецидива. Проводили многофакторный анализ методом классификационных деревьев для формирования шкалы комплексной оценки риска развития остеомиелита (КОРРО).

Результаты. В КОРРО были включены факторы, влияющие на результат лечения: локализация (r = 0,205; p = 0,019); длительность остеомиелита (r = 0,23; p = 0,007); наличие санирующих операций в анамнезе (r = 0,264; p = 0,002); объем костного дефекта (r = 0,175; p = 0,045); физиологический класс по классификации Cierny–Mader (r = 0,188; p = 0,004); анатомический тип остеомиелита по Cierny–Mader (r = 0,15; p = 0,086); характер возбудителя (r = 0,123; p = 0,162). Установлена степень риска развития рецидива остеомиелита, а также пороговые значения для количественных показателей и суммарного балла по КОРРО. У пациентов с показателем более 5 баллов по КОРРО при одноэтапном лечении риск развития рецидива остеомиелита возрастал в 8,1 раза в сравнении с пациентами, имеющими показатель 5 баллов и менее (ОР 8,143; ДИ 1,008–65,882). При двухэтапном лечении пациентов с показателем более 5 баллов риск развития рецидива остеомиелита возрастал в 4,1 раза в сравнении с больными с показателем 5 баллов и менее по КОРРО (ОР 4,059; ДИ 0,461–35,714). На основании КОРРО разработан алгоритм выбора тактики лечения профильных пациентов.

Заключение. К значимым факторам риска развития рецидива инфекции относятся локализация, длительность остеомиелита, наличие санирующих операций в анамнезе, объем костного дефекта, характер возбудителя, физиологический класс и анатомический тип остеомиелита по классификации Cierny–Mader. Разработанная на основании этих факторов шкала комплексной оценки риска рецидива остеомиелита позволяет спрогнозировать развитие рецидива инфекции и выбрать рациональную тактику хирургического лечения.

Ключевые слова: остеомиелит длинных костей, факторы риска рецидива, полостной костный дефект.

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INTRODUCTION

The number of orthopedic surgical interventions on bones and joints increases annually, with infectious complications developing in 1-17% of cases postoperatively [1]. The presence of comorbidities in patients, such as diabetes, obesity, atherosclerosis, alcoholism, and smoking, increases the risk of infection at the surgical site following osteosynthesis [2, 3, 4]. Approximately half of the cases of osteomyelitis of long bones involve the tibia, 30% involve the femur, and the remaining 20% are accounted for by the fibula, humerus, ulna, and radius [5, 6, 7, 8]. The treatment of osteomyelitis is associated with a significant number of unsatisfactory outcomes, with the rate of disability reaching 50-90% [9, 10, 11].

The threat to life due to infection generalization, disability, limb shortening, malignancy, compromised weight-bearing capacity, and impaired function of the affected limb in patients with osteomyelitis highlight the significant social and economic impact of this disease [12, 13]. Additionally, treating musculoskeletal infections requires substantial financial resources from the healthcare system [14, 15]. Surgical treatment of chronic osteomyelitis results in recurrence in 20-30% of cases and leads to limb amputation in 0.13-16.75% of cases [16, 17, 18, 19].

Limb-sparing surgical treatment is based on the following principles: radical debridement, adequate soft-tissue wound closure, restoration of bone tissue defects and stabilization of the limb segment, systemic and local antibiotic therapy, limb reconstruction, and rehabilitation. Following radical debridement of the osteomyelitis focus, bone defects are formed, which must be filled to restore the bone's weight-bearing capacity and control inflammation [20]. There are one- and two-stage methods for bone defect replacement. In one-stage treatment, the bone defect is filled with biological or synthetic bone graft material simultaneously with the radical debridement of the osteomyelitis [21, 22]. In the two-stage treatment method, an antimicrobial spacer based on polymethylmethacrylate is placed at the first stage [23]. At the second stage, the infection having been managed, the bone cement is replaced with a biodegradable material.

In surgical interventions involving the filling of residual bone cavities, several issues remain unresolved concerning the methods and materials for bone grafting, as well as the factors influencing treatment outcomes.

The limited number of studies and the low level of evidence regarding the effectiveness of studied osteomyelitis treatment methods contribute to the lack of clear guidelines for managing these patients. Thus, the question of choosing an optimal method for filling bone cavities in patients with chronic osteomyelitis remains open.

The aims of the study are to identify significant risk factors for infection recurrence in one- and two-stage cavity defect replacement with synthetic materials in patients with chronic osteomyelitis and, based on the findings, to develop a surgical treatment algorithm for this patient population.

METHODS

The study was based on unpublished materials from the thesis of A.V. Afanasyev*.

The retrospective study included 131 patients treated for chronic osteomyelitis in the Department of Purulent Osteology from 2009 to 2018.

All patients who underwent one- or two-stage osteomyelitis treatment and met the following criteria were included:

- presence of chronic osteomyelitis of long bones of types III and IV, physiological classes A and B (according to the Cierny-Mader classification);
- filling of the bone cavity defect with an antimicrobial spacer in the form of beads (in the first stage for two-stage treatment), calcium sulfate with tobramycin (Osteoset T), or β-tricalcium phosphate with hydroxyapatite (ReproBone) and an antibiotic (in one-stage treatment or in the second stage of two-stage treatment);
- satisfactory condition of the soft tissues, allowing for adequate closure of the surgical wound without soft tissue grafting;
- ability to undergo prolonged (at least 6-8 weeks), including oral antibiotic therapy;
- absence of signs of chronic osteomyelitis exacerbation: clinical (infiltration, significant edema and hyperemia of the soft tissues, local

* Afanasyev, A.V. Differentiated approach to the choice of treatment tactics for patients with chronic osteomyelitis with cavity defects of long tubular bones: Thesis … Cand. Med. Sci. – St. Petersburg, 2022. – 184 p.

hyperthermia, infectious inflammation of the subcutaneous tissue, fasciitis, fluid accumulation in the soft tissues) and/or systemic inflammatory response syndrome;

- absence of untreated foci of infection in other locations (e.g., trophic ulcers, genitourinary infections, oral cavity infections, and others).

All patients underwent surgical debride-ment of the infection site, performing a "fenestrated" osteotrepanation for thorough debridement of the osteomyelitis focus down to healthy bone (positive "pinpoint bleeding" sign). This was followed by extensive wound irrigation with antiseptic solutions (3% hydrogen peroxide, 0.05% chlorhexidine, 0.1-0.2% Lavasept) and saline solution. Subsequently, the bone defect was filled with synthetic materials using the one- or two-stage method.

To identify significant risk factors for osteomyelitis recurrence, patients were divided into two groups (Figure 1):

Group 1 (n = 90) – patients with chronic osteo-myelitis of long bones in whom infection was managed as a result of one- or two-stage treatment;

Group 2 (n = 41) – patients who experienced osteomyelitis recurrence after one-stage treatment or during two-stage treatment (after the first or second stage).

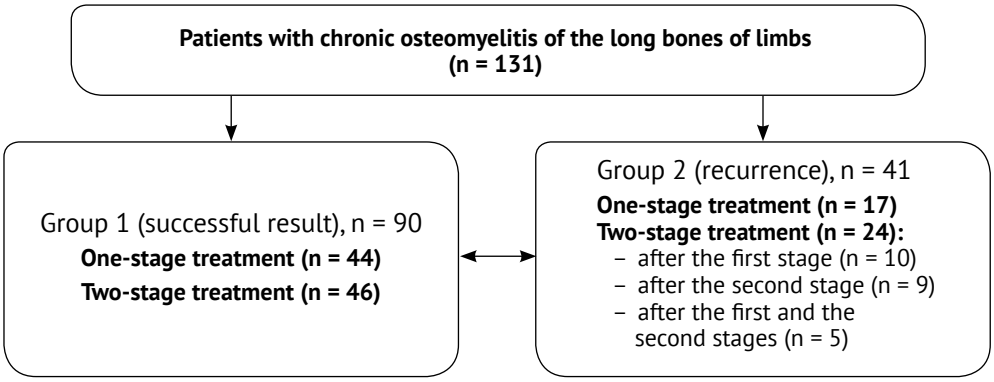


Figure 1. Study design flowchart

Infection was considered managed in the absence of signs of inflammation for at least one year postoperatively (e.g., elevated body temperature, swelling, hyperemia, significant pain syndrome, prolonged discharge from the surgical wound (more than 10 days), leukocytosis, and fistula formation). In the overall sample, the mean follow-up period was 43 months.

Osteomyelitis recurrence was identified in 17 (28%) of 61 patients after one-stage treatment, in 15 (21%) of 70 patients after the first stage, and in 14 (20%) of 70 patients after the second stage of two-stage treatment.

An electronic database was created, including possible risk factors for the infectious complications: age, sex, localization of the lesion, pathogenesis and etiology of osteomyelitis, leukocyte count and level of C-reactive protein (CRP), duration of surgery and volume of blood loss, size of the bone defect, presence and number of previous debridement operations, duration of osteomyelitis, and anatomical type and physiological class according to the Cierny-Mader classification.

Statistical analysis

Statistical analysis of the obtained results was performed using GraphPad Prism 6.0 software. The age of patients was presented as mean values with 95% confidence intervals (CI 95%), while other quantitative variables were presented as medians with 25-75% interquartile ranges [IQR 25-75%]. At the first stage, differences between groups were assessed to identify factors significantly influencing the risk of recurrence using the Mann-Whitney U test for quantitative data. Additionally, the relationship between phenomena was examined using Spearman's rank correlation coefficient (r). Qualitative data were presented as counts of events, and Fisher's exact test was used to evaluate the significance of differences between groups. Differences were considered statistically significant at $p<0.05$. At the second stage, after the preliminary selection of significant risk factors for recurrence, multifactorial analysis was conducted using classification trees to determine the importance of factors and their

threshold values for developing a scale for Comprehensive Osteomyelitis Recurrence Risk Assessment (CORRA). The relative risk (RR) was used to assess the risk of osteomyelitis recurrence based on the total score from the CORRA.

RESULTS

The distribution of patients by age, gender, localization, duration, and pathogenesis of osteomyelitis was comparable between the groups (Table 1). However, in Group 2, there was a significantly higher proportion of patients with a history of debridement operations and a higher median volume of the bone defect compared to Group 1.

No significant differences in the etiology of osteomyelitis were found between the groups, with staphylococci being the predominant pathogens (Table 2).

We did not find a correlation between the recurrence of infection in these patients and their age ($r=-0.0054$; $p=0.95$), sex ($r=-0.0197$; $p=0.823$), pathogenesis of osteomyelitis ($r = -0.0627$; $p = 0.477$), leukocyte count ($r = 0.0485$; $p = 0.582$), and CRP level ($r = 0.0741$; $p = 0.423$) prior to surgery, which led to the exclusion of these variables from further analysis.

For the development of the CORRA, factors that had a direct statistically significant relationship with the development of recurrence were included: localization ($r = 0.205$; $p = 0.019$); duration of osteomyelitis ($r = 0.23$; $p = 0.007$); presence of debridement operations in the medical history ($r = 0.264$; $p = 0.002$); volume of the bone defect ($r = 0.175$; $p = 0.045$); and physiological class according to the Cierny-Mader classification ($r = 0.188$; $p = 0.004$). The study established that a larger proportion of osteomyelitis recurrences occurred in patients with type IV anatomical classification (according to Cierny-Mader) — 50% (8 out of 16) — as well as in those with Gram-negative and MRSA pathogens — in 42.9% (12 out of 28) of cases. Based on the above, the anatomical type of osteomyelitis according to the Cierny-Mader classification ($r = 0.15$; $p = 0.086$) and the nature of the pathogen ($r = 0.123$; $p = 0.162$) were also included in the CORRA.

Based on the obtained data, multifactorial statistical analysis allowed for the determination of the risk degree for osteomyelitis recurrence, as well as threshold values for quantitative indicators and the total score on the CORRA (Table 3).

It was established that a total score from 0 to 5 on the CORRA categorizes a patient as low risk for osteomyelitis recurrence, while a score exceeding 5 indicates a high risk of recurrence, as confirmed by the treatment outcomes of the patients included in the study (Table 4).

Table 1

Characteristics of patients in the study groups

Parameter		Group 1 (n = 90)	Group 2 (n = 41)	p
Age, y.o., Me [IQR 25-75%]		43 [31-55]	41 [33-50]	0.90
Male, n (%) Female, n (%)		54 (60) 36 (40)	24 (59) 17 (41)	1.00
Localization, n (%):	thigh upper arm lower leg	21 (23.3) 12 (13.3) 57 (63.3)	16 (39) 1 (2) 24 (59)	0.09 0.06 0.07
Pathogenesis of osteomyelitis, n (%):	posttraumatic hematogenous postoperative	26 (29) 21 (23) 43 (48)	14 (34) 6 (15) 21 (51)	0.50 0.35 0.85
Debridement operations, n (%):		69 (77)	38 (93)	0.03
Anatomical type: 3, n (%) 4, n (%)		 82 (91) 8 (9)	 33 (80) 8 (20)	 0.09
Physiological class, n (%):	A B	9 (10) 81 (90)	– 41 (100)	– 0.06
Osteomyelitis duration, years, Me [IQR 25-75%]		2 [1-5]	4 [1-14]	0.06
Volume of bone defect, ml, Me [IQR 25-75%]		10 [7-8]	15 [8-30]	0.04

Table 2

Etiology of infection in the study groups, n (%)

Etiology of infection	Group 1 (n = 90)	Group 2 (n = 41)	p
S. aureus, S. epidermidis and other coagulase-negative staphylococci	74 (82)	29 (71)	0.17
MRS*-related	9 (10)	8 (19)	0.16
Gram(-)-related **	7 (8)	4 (10)	0.74
Total	90 (100)	41 (100)	

* — MRS — methicillin-resistant strains.
** — including *fam. Enterobacteriaceae, Pseudomonas aeruginosa*.

Table 3

Scoring of the Comprehensive Osteomyelitis Recurrence Risk Assessment scale (CORRA*)

Factor	Score		
	0	1	2
Proportion of patients with osteomyelitis recurrence			
Localization	Upper arm 7.7% (1 out of 13)	Lower leg 29.6% (24 out of 81)	Thigh 43.2% (16 out of 37)
Osteomyelitis duration	<5 years 24.7% (23 out of 93)	>5 years 47.4% (18 out of 38)	–
Number of debridement operations	0 8.7% (2 out of 23)	1 28% (14 out of 50)	>1 43.1% (25 out of 58)
Volume of bone defect, cm^3	<5 10% (2 out of 20)	5-19 28.6% (20 out of 70)	≥20 46.3% (19 out of 41)
Anatomical type	3 28.7% (33 out of 115)	4 50% (8 out of 16)	–
Physiological class	A 0% (0 out of 9)	B 33.6% (41 out of 122)	–
Pathogen	Gram(+), except MRSA and MRSE, 28.2% (29 out of 103)	Gram(-) 36.4% (4 out of 11) MRSA/MRSE 47.1% (8 out of 17)	–

* To determine the total CORRA score, it is necessary to add up all the scores obtained.

Table 4

Frequency of osteomyelitis recurrence in patients using β-tricalcium phosphate with hydroxyapatite depending on the sum of CORRA scores

Outcome	One-stage treatment (n = 26)		Two-stage treatment (n = 40)	
	0-5 points	>5 points	0-5 points	>5 points
No recurrence	18 (94.7%)	4 (57.1%)	22 (95.7%)	14 (82.4%)
Recurrence	1 (5.3%)	3 (42.9%)	1 (4.3%)	3 (17.6%)
Total	19 (100%)	7 (100%)	23 (100%)	17 (100%)

Additionally, a statistically significant moderate positive correlation was found between the total CORRA score and the development of osteomyelitis recurrence (r = 0.35; p = 0.00389).

To exclude the influence of the bone grafting material on the treatment outcome, the CORRA was tested in patients using only β-tricalcium phosphate with hydroxyapatite impregnated with antibiotic during one- and two-stage filling of the bone defect. The average CORRA score for these patients undergoing one-stage treatment was 4 [IQR 4-5], which did not significantly differ from the corresponding value in the two-stage treatment group, which was 5 [IQR 4-7] (p = 0.11). However, the recurrence rate in patients with a score greater than 5 was statistically significantly higher than in patients with 0-5 points on the CORRA (p = 0.016). Thus, a total score greater than 5 on the CORRA increases the risk of recurrence after one- and two-stage treatment of osteomyelitis by 5.25 times (OR = 5.25; CI 1.149-23.997).

It was also found that in patients with a score greater than 5 on the CORRA during one-stage treatment, the risk of osteomyelitis recurrence increased 8.1 times compared to patients with a score of 5 or fewer (OR = 8.143; CI 1.008-65.882). The recurrence rate during one-stage treatment was 42.9% for patients with a total score greater than 5 and 5.3% for those with 5 points or fewer on the CORRA (p = 0.019). In two-stage treatment, patients with a score greater than 5 on the CORRA had a 4.1 times increased risk of osteomyelitis recurrence compared to patients with 5 points or fewer (OR = 4.059, CI 0.461-35.714). The recurrence rates during two-stage treatment were 17.6% and 4.3% among patients with a total score greater than 5 and 5 points or fewer on the CORRA, respectively (p = 0.019) (p = 0.166).

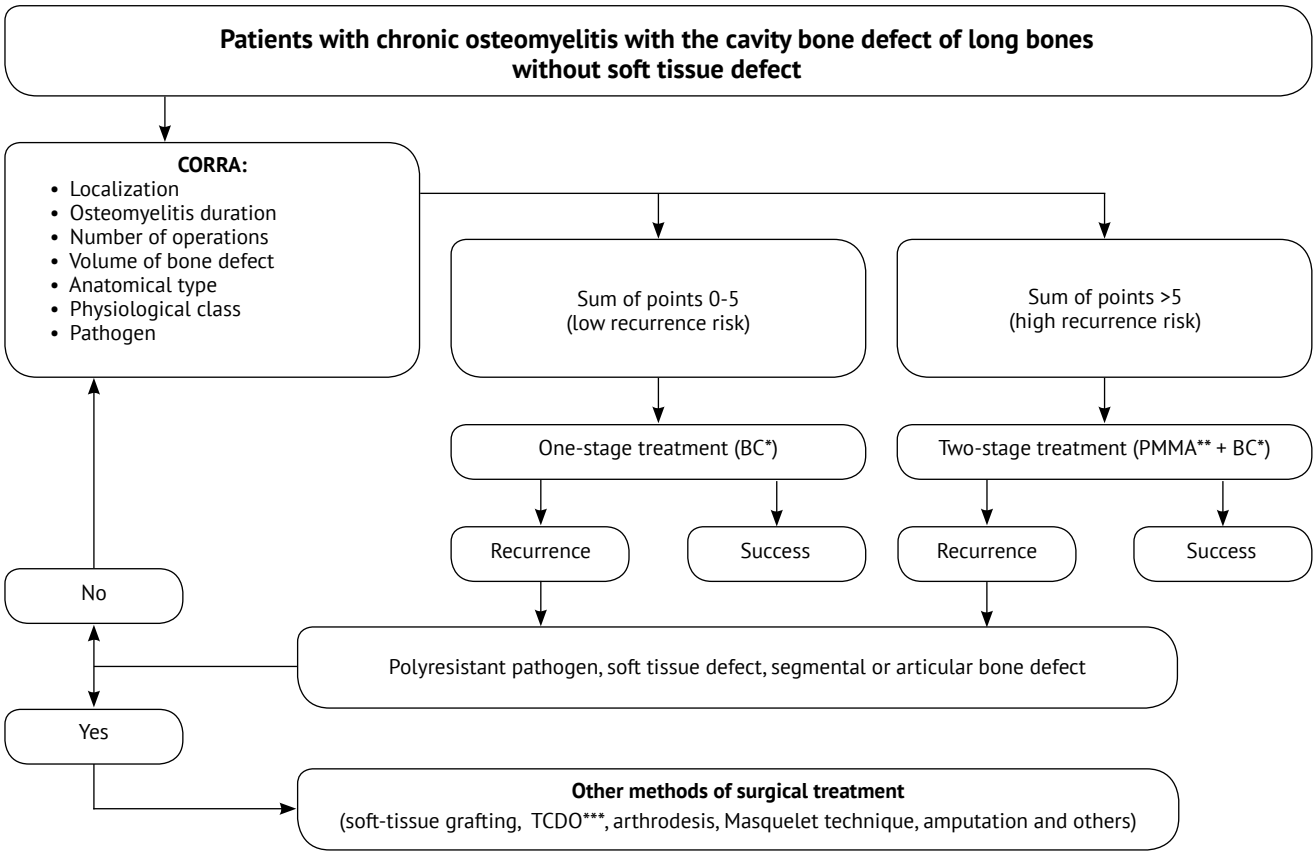
Thus, for patients with a score of ≤5 on the CORRA, a one-stage procedure may be the operation of choice. For those with a total score greater than 5 on the CORRA, it is advisable to opt for a two-stage treatment method due to the lower risk of osteomyelitis recurrence.

Based on the results obtained from the conducted research and practical experience in treating patients, we formulated an algorithm for choosing a treatment strategy (Figure 2). The total score on the CORRA is calculated based on the patient's medical history and the results of clinical and laboratory examinations.

With a total score of 0 to 5, one-stage surgical treatment using a biocomposite osteo-replacement material is feasible. The choice of antibiotic depends on the results of microbiological testing; in the absence of such data, it is recommended to use broad-spectrum agents, such as fosfomycin or a combination of vancomycin with a drug active against Gram-negative pathogens.

For scores greater than 5 on the CORRA, two-stage treatment is preferred, using an antimicrobial spacer in the first stage and a biocomposite osteo-replacement material in the second stage.

In the event of an infection recurrence, it is necessary to assess the nature of the pathogen, the condition of the soft tissues, and the possible type of bone defect following the debridement. If a polymicrobial resistant pathogen is identified, preventing adequate local and systemic antibiotic therapy, the next step is to perform the muscle grafting of the bone defect. In cases of segmental or joint defects, reconstructive plastic operations are indicated to restore the bone defect or perform arthrodesis, often using external fixators (the Ilizarov technique) [24] or, less frequently, internal fixators (locking intramedullary osteosynthesis with antimicrobial cement coating, Masquelet technique) [25]. For soft tissue defects, soft tissue plastic surgery with a non-free or free flap is recommended [26, 27]. If a cavity bone defect in chronic osteomyelitis is associated with a soft tissue defect, the CORRA score is used to decide between one- or two-stage reconstruction in combination with skin-fascia or muscle grafting, or if possible, treatment may be performed using only a muscle flap. If the affected limb lacks the potential for functional recovery through reconstructive plastic surgeries, amputation should be considered as possible surgical treatment for the patient.



BC* — biocomposite material; PMMA** — polymethylmethacrylate; TCDO*** — transosseous compression-distraction osteosynthesis

Figure 2. Treatment algorithm for patients with chronic osteomyelitis of long bones

DISCUSSION

In our study, we did not find any correlation between the recurrence of osteomyelitis and age, gender, the pathogenesis of osteomyelitis, or laboratory indicators of inflammation (leukocytes and CRP), which aligns with findings from the scientific literature. The lack of influence of laboratory data (ESR, leukocyte count, CRP), gender, and age of the patient on the recurrence of infection when studying risk factors for the development of recurrent chronic osteomyelitis has also been noted in the works of A. Yalikun et al. in their analysis of the treatment of 149 patients [28] and K.N. Subramanyam et al., who analyzed the treatment outcomes of 147 patients with this condition [29].

Back in 1985, E.R. Wald identified that the primary risk factor for the development of chronic bone infections is the lack of thorough sanitation or delayed treatment of acute osteomyelitis [30]. In our study, we formulated CORRA based on the risk factors for the recurrence of chronic osteomyelitis established during the first stage of statistical analysis, including localization, duration of osteomyelitis, number of debridement operations in the medical history, volume of bone defect, type of pathogen, physiological class, and anatomical type according to the Cierny-Mader classification.

The significance of the pathogen, the number of previous debridement operations, comorbidities, and bone defect in the development of recurrent infection has been noted in the works of other authors [28, 31, 32, 33, 34].

H. Wu et al. noted in their analysis of the treatment outcomes of 341 patients with chronic osteomyelitis that segmental bone defects, gram-negative infections, and smoking are risk factors for recurrence [31]. A. Yalikun et al. determined that in the treatment of patients with chronic posttraumatic osteomyelitis of the tibia using the Ilizarov method, the main

risk factors for recurrent infection are the pathogen *Pseudomonas aeruginosa*, soft tissue defects with bone exposure, and the number of previous operations (more than three) [28], which corresponds with the results of our study. These authors also classified the presence of a soft tissue defect as a risk factor for infection recurrence. However, patients with this condition were not included in our study.

In the treatment of 424 patients with chronic osteomyelitis of the long bones of the extremities using the Masquelet technique, X. Wang et al. found that the recurrence rate of infection in posttraumatic osteomyelitis was significantly higher than in hematogenous osteomyelitis [32]. However, our study did not reveal a significant impact of this factor on treatment outcomes.

X. Wang et al. also identified the number of repeated operations exceeding three, localization of the process in the tibia, and the presence of *Pseudomonas aeruginosa* as risk factors for the recurrence of osteomyelitis. A notable difference from our results is that the involvement of the femur carries a higher risk of recurrence compared to the involvement of the tibia. This may be related to the fact that X. Wang et al. included patients with soft tissue defects in a single general group, while chronic osteomyelitis of the lower leg is more frequently associated with soft tissue defects than other localizations. Additionally, X. Wang et al. evaluated treatment outcomes in patients with segmental bone defects, which may have influenced the discrepancies with our findings.

N.S. Shah et al. reported a 51% recurrence rate of infection in a two-stage treatment of 257 patients with posttraumatic osteomyelitis. They identified diabetes mellitus, intravenous drug use, and open fractures of the tibia as risk factors for unsatisfactory treatment outcomes [33]. According to the Cierny-Mader classification, diabetes mellitus and intravenous drug use correspond to physiological class B, which is also a risk factor in our study. P.M. Preobrazhensky et al. established that chronic iron-deficiency anemia, kidney disease, obesity, and cardiovascular pathology significantly influence the development of recurrent periprosthetic infections [34]. This aligns with the results of our study, as these conditions fall under physiological class B according to the Cierny-Mader classification. A multifactorial analysis using classification trees enabled P.M. Preobrazhensky et al. to develop a comorbidity score to determine the risk of recurrent periprosthetic infection, while in our study, this analysis assisted in creating CORRA for chronic osteomyelitis of long bones.

Limitations of the study

The limitation of our study is its retrospective nature and the inclusion of a small number of observations, which was determined by strict inclusion criteria, as well as the use of two different biocomposite materials for filling cavity defects. This necessitates further validation of the proposed method for scoring using CORRA and the formulated algorithm for the choice of treatment tactics within the framework of a prospective study.

CONCLUSIONS

Significant risk factors for the recurrence of infection in patients with chronic osteomyelitis have been identified (localization, duration of osteomyelitis, presence of debridement operation sin the medical history, volume of the bone defect, nature of the pathogen, physiological class, and anatomical type of osteomyelitis according to the Cierny-Mader classification), which facilitated the creation of a scale for Comprehensive Osteomyelitis Recurrence Risk Assessment (CORRA). The application of CORRA may assist in predicting the potential development of infection recurrence in relevant patients and in selecting a rational surgical treatment strategy in each specific case according to the formulated algorithm, which requires further research.

DISCLAIMERS

Author contribution

All authors made equal contributions to the study and the publication.

All authors have read and approved the final version of the manuscript of the article. All authors agree to bear responsibility for all aspects of the study to ensure proper consideration and resolution of all possible issues related to the correctness and reliability of any part of the work.

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