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Treatment Tactics and Complications after Surgical Treatment of HIV-Infected Patients with Extra-Articular Fractures of the Long Bones of Extremities

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THE AIM OF THE STUDY is the comparative analysis of the long-term results of treatment of extra-articular fractures of the long bones in HIV-infected and non-HIV-infected patients.

MATERIAL AND METHODS In the presented study, a comparative analysis of the results of surgical treatment of 90 HIV-infected and 112 HIV-uninfected patients with extra-articular fractures of the long bones of the extremities aged from 23 to 54 years was performed.

Results HIV-infected patients are mainly characterized by non-infectious complications from the postoperative wound (formation of seromas, hematomas, dehiscence of the edges of wounds, delayed healing), aseptic loosening and migration of fixators, and delayed consolidation of fractures. The presence of statistically significant relationships between the factors characterizing the course of HIV infection (stage of the disease, the number of CD4 + lymphocytes, the ratio of CD4/CD8 + lymphocytes, viral load) and the risk of postoperative complications was revealed.

CONCLUSION Thus, the use of standard algorithms for determining the tactics and method of treatment of extra-articular fractures of the long bones of the extremities in HIV-infected patients leads to a significant number of unsatisfactory treatment results (up to 31.1%). For HIV-infected patients, the most typical are non-infectious complications from postoperative wound, impaired fracture consolidation processes and aseptic loosening of metal fixators, which can lead to the development of infectious complications. Expansion of research in this area with an increase in the number of observed contingents will make it possible to develop a scientifically based scale for predicting the development of possible postoperative complications in this category of patients.

Keywords: bone fractures, HIV infection, AIDS, osteosynthesis, reduction, complications of surgical treatment

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EFD – external fixation device

ARVT – antiretroviral therapy

HIV – Human Immunodeficiency Virus

WHO – World Health Organization

EAFLBE – extra-articular fractures of long bones of extremities

BMD – bone mineral density

OR – odds ratio

AIDS – Acquired Immunodeficiency Syndrome

INTRODUCTION

By the beginning of 2019, the number of HIV-infected people in the world amounted to more than 0.5% of the total population of the planet. Over the past 5 years, the number of HIV-infected people in the world has doubled and World Health Organization (WHO) predicts an increase in the number of such cases by 15-25% per year [1].

More than 80,000 new cases of HIV infection are detected in the world every, more than 90% of HIV-infected patients are the working-age population [1]. According to the Federal Scientific and Methodological Center for the Prevention and Control of AIDS in Russia, as of December 31,

2017, the presence of HIV infection was confirmed in 1.22 million people [2]. The HIV prevalence rate of the residents of the Russian Federation in 2018 was 686.2 per 100,000 population [3].

Taking into account the growth of the prevalence rate, the number of HIV-infected elderly people is increasing. Due to the physiological characteristics of the state of the skeletal system in elderly people, the characteristics of the course of HIV infection, the side effects of antiretroviral therapy (ARVT) in relation to bone mineral density (BMD), such patients are at risk of limb injuries [4].

Currently, the mortality rate in HIV infection tends to decrease due to the use of ARVT, and the life expectancy of HIV-infected patients is increasing [5, 6]. However, the issues of treating somatic pathology, in particular, limb injuries in HIV-infected patients, including people of comparatively young working age, remain relevant [7, 8].

A decrease in BMD in HIV-infected people, both young and old, has been identified in many previous studies [9, 10]. There was a threefold increase in the incidence of osteoporosis in HIV-infected patients compared with the average BMD for HIV-uninfected people [11-13], especially while taking ARVT [14]. It was also found that there is a 30–70% increase in the number of fractures in HIV-infected patients compared with similar groups without HIV [15]. It has been proven that starting antiretroviral drugs stimulates a clinically significant decrease in BMD by 2–6%, regardless of the ARVT regimen used [16–19].

Immunosuppression and the effect of HIV proteins on the cells of the nervous and connective tissue of HIV-infected patients increase the risk of complications after surgery [20]. These complications are both infectious and non-infectious, and often require repeated surgeries, which, in turn, leads to an increase in the duration and cost of treatment [21]. In the Russian Federation, there is currently no evidence base regarding the causes of the developed postoperative complications in HIV-infected trauma patients.

Insufficient knowledge among practitioners about the stages of HIV infection and the characteristics of its pathogenesis often leads to the refusal of surgical intervention in HIV-infected patients with bone fractures in favor of conservative treatment. This, in turn, leads to disruption of the processes of fracture healing, an increase in the period of disability, incomplete restoration of the function of the injured limbs and disability of the injured. [22].

Against this background, the lack of a systematic approach in the tactics of examination, treatment and rehabilitation of this group of patients leads to a significant number of complications [4, 15, 19].

Purpose of the study. On the basis of a comparative analysis of the results of surgical treatment of extra-articular fractures of the long bones of the extremities (EAFLBE) in HIV-infected and non-HIV-infected patients, identify the distinctive features in the structure of postoperative complications and propose a scientifically substantiated algorithm for determining the tactics and method of their treatment.

Research objectives:

1. Determine the differences in the structure and incidence of postoperative complications in HIV-infected patients with EAFLBE.
2. To reveal the presence of a statistically significant relationship between objective factors characterizing the course of concomitant HIV infection in this category of patients and the risk of postoperative complications.
3. On the basis of the analysis, to propose an algorithm for determining the tactics and method of treating EAFLBE in HIV-infected patients.

MATERIAL AND METHODS

A retrospective study was conducted on the basis of the State Clinical Hospital named after F.I. Inozemtsev DZM for 2014–2018 (specialized institution in the field of treatment of injuries and diseases of the musculoskeletal system in HIV-infected patients in Moscow). For the analysis, the medical histories of surgical treatment of 90 HIV-infected (main group) and 112 uninfected HIV patients (comparison group) with closed EAFLBs were selected.

The tactics of managing patients in both groups was the same and was carried out according to generally accepted algorithms.

All patients underwent routine research methods (clinical analysis of blood, urine, biochemical blood test, coagulogram, chest x-ray and x-ray of an injured segment of the limb). In the blood serum, the enzyme immunoassay was used to determine the markers of viral hepatitis B and C, the study for anti-HIV, immune status, determination of the viral load by HIV RNA in plasma.

During the rehabilitation period, the patients were observed until the moment of fracture consolidation: with fractures of the humerus after 2, 6, 12 weeks, then until the moment of consolidation every 2 weeks; for fractures of the femur and lower leg bones after 2, 6, 12, 16 weeks, then until the moment of consolidation every 4 weeks.

Surgical treatment for all patients with EAFLBE was carried out in the period from the 1st to the 7th day from the moment of injury, on average after 3.8 ± 1.6 days. We used all the current methods of osteosynthesis, including intramedullary, extra-bone, extrafocal compression-distraction osteosynthesis, including the technique of minimally invasive osteosynthesis with the use of a bone plate — MIPO (minimally invasive plate osteosynthesis).

The results of treatment were assessed using the Luboschitz – Mattis – Schwarzeberg scale according to 9 parameters (range of motion, segment shortening, deformity, radiological signs of consolidation, limb atrophy, vascular disorders, neurological disorders, purulent complications, recovery of working capacity), each of which was assessed from 2 to 4 points [23].

The calculation of the sum of points followed by dividing by the number of assessed indicators on the Luboschitz – Mattis – Schwarzeberg scale made it possible to judge the outcomes of surgical treatment: with an index of 3.5–4.0 points, the treatment result was considered good, 2.5–3.5 points – satisfactory, 2.5 points or less – unsatisfactory result.

Patients with open fractures or concomitant diseases (diabetes mellitus, tuberculosis, liver, kidney diseases, various connective tissue diseases, chronic infections, tumors, etc.) affecting the healing of a postoperative wound were not included in the study.

To determine the clinical stage of HIV infection, the classification adopted in the Russian Federation was used [24].

Statistical analysis was performed using programs STATISTICA (Data analysis software system, StatSoft, Inc. 2010), IBMSPSS (IBMCorp. 2015). To assess the statistical significance of quantitative indicators, the Student's t-test was used. The criterion for the statistical reliability of the results obtained was the value $p < 0,05$ (95%).

RESULTS

From 2014 to 2018, the number of HIV-infected patients who applied to the admission department of our clinic increased from 52 to 236 people, and those operated on for EAFLBE from 12 to 54 patients. Of 90 patients with HIV infection, 66 (73.4%) were infected due to intravenous use of psychoactive substances (PAS).

The cause of the fracture in 70 patients (77.78%) out of 90 of the main group was a domestic injury, a sports injury in 11 (12.22%), a road injury in 6 (6.67%), an industrial injury in 3 (3.33%) victims. The average age of patients in this group was 38 ± 2.4 years (from 23 to 54 years). The main group consisted of 28 women (31.1%) and 62 men (68.9%). In terms of social status, there were 18 employees (20.0%), physical workers – 49 (54.4%), students – 2 (2.2%), pensioners – 31 (34.4%). The distribution of patients in this group, taking into account the stage of HIV infection, was as follows: I-III stages were detected in 58 patients (64.4%), IVA in 8 (8.9%), IVB and IVB – in 24 (26.7%).

The comparison group included 112 uninfected HIV patients with ICPD. 77 victims (68.75%) had a household injury, a sports injury – in 18 (16.07%), a road injury – in 43 (38.4%), an industrial injury – in 6 (5.36%) patients). The average age of patients at the time of injury was 36 ± 4.7 years (from 19 to 52 years). The group consisted of 45 women (40.1%) and 67 men (59.9%). According to their social status, patients were distributed as follows: office workers – 38 (33.9%), people of physical labor – 65 (57.1%); students – 7 (6.25%), pensioners – 2 (1.8%).

Patients of both groups were comparable in gender, age and energy of the received trauma ($p > 0.05$).

The distribution of patients in the main group and the comparison group, depending on the localization of the ICPD and their type according to the classification of the Osteosynthesis Association (AO / OTA) are presented in Table. 1.

Table 1
Distribution of patients by location and type of fracture

Segment number AO/OTA	Fracture location					
	Brachial bone		Femur		Shin bones	
	Main	Comparison	Main	Comparison	Main	Comparison
1 A	4	5	12	19	3	6
1 B	-	-	7	9	1	1
2 A	9	9	4	7	2	6
2 B	5	7	7	7	4	10
2 C	3	8	2	4	2	7
3 A	-	-	5	4	6	5
Total (abs, %)	21 (27.6%)	29 (25.9 %)	37 (48.7%)	48 (42.9%)	18 (23.7%)	35 (31.2%)

In the observed groups, the number of patients was comparable in terms of the number of fractures of each individual location (statistically insignificant differences, $p > 0.05$, t-test 1,237).

The distribution of patients in the main group, depending on the presence or absence of ARVT in the anamnesis and the mechanism of the injury received is shown in Table. 2.

Table 2
Distribution of patients in the main group depending on the ARVT in the anamnesis and the mechanism of the injury received

Energy of trauma	Observation groups			
	Without ARVT	In the course of ARVT	Injury within first 2 years of ARVT	Total
Low energy	12	52	14	64 (71.1%)
High energy	16	10	7	26 (28.9 %)
Total	28 (31.1%)	62 (68.9%)	21 (33.9%)	90 (100%)

Note: ARVT – antiretroviral therapy

From table. 2 it follows that 28 HIV-infected patients (31.1%) did not receive ARVT, and in the first 2 years after starting ARVT, 21 patients were injured, which amounted to 33.9% of the total number of patients receiving ARVT.

Among HIV-infected patients receiving ARVT, fractures due to low-energy trauma were more common. Of the 64 patients who received low-energy trauma, 52 (81.13%) received ARVT; in 21 patients (23.3%), about 2 years have passed since the appointment of ARVT, when, against the background of ARVT, the BMD indicator reaches the minimum [25].

Comparison of the treatment results (outcome) of patients in the two groups according to the Luboschitz-Mattis-Schwarzeberg scale is presented in Table. 3.

Table 3

Treatment outcomes of patients in the two groups according to Luboshits-Mattis-Schwarzberg scale

Treatment result EAFLBE	Groups		Statistical differences (p)
	Main, abs . (%)	Comparison, abs . (%)	
Good	29 (32.2)	91 (81.3)	<0.05
Satisfactory	33 (36.7)	19 (16.9)	<0.05
Unsatisfactory	28 (31.1)	2 (1.8)	<0.05

Note: EAFLBE — extra-articular fractures of the long bones of extremities

Analysis of the results of treatment of patients in two groups allows us to conclude that there is a statistically significant difference in treatment outcomes. If good results of surgical treatment were achieved in 91 patients in the comparison group (81.3%), then in patients with HIV infection, a good outcome of treatment was registered only in 29 patients (32.2%). On the contrary, an unsatisfactory result of treatment in the comparison group was registered only in 2 patients (1.8%), and in the main group of HIV-infected – in a third of patients – 28 (31.1%).

The average duration of inpatient treatment of HIV-infected patients of the main group was 14.4 ± 1.4 bed-days ($p < 0.05$, $t = 4.294$, this is more than the critical value $t = 1.990$ for $f = n-1 = 89$), which indicates the presence of a statistically significant difference in the duration of treatment of patients in this group, which was probably associated with the development of early postoperative complications.

The period of rehabilitation treatment in patients of the main group until the closure of the certificate of incapacity for work and return to work in case of fractures of the humerus, in patients with work not associated with heavy physical exertion, was 4.62 ± 2.11 weeks, and in patients engaged in physical labor – 15.04 ± 3.31 weeks ($p < 0.05$, $t = 3.549$). With fractures of the femur, the total period of disability of patients was 33.24 ± 5.64 weeks ($p < 0.05$, $t = 2.225$). With fractures of the shin bones, the total period of disability was 26.33 ± 3.99 weeks ($p < 0.05$, $t = 2.592$).

An increase in the bed-day and the period of disability in HIV-infected patients with EAFLBE (up to 67.7% of the inpatient stage and up to 34.9% of the period of disability) led to an increase in economic costs (up to 40.28% or up to 400,000 rubles, depending on localization of damage).

The structure and incidence of postoperative complications in patients of the observation groups are presented in Table. 4.

Table 4

The incidence of postoperative complications in patients with extra-articular fractures of the long bones of extremities in the study and control groups

Postoperative complications	Observation groups		Statistical differences (p)
	Main, abs . (%)	Comparison, abs . (%)	
Non-infectious complications of a postoperative wound	38 (42.2%)	5 (4.5%)	<0.05
Aseptic loosening of metal fixators	29 (32.2%)	1 (0.9%)	<0.05
Migration of metal fixators	17 (18.9%)	3 (2.7%)	<0.05
Slow consolidation	48 (53.3%)	2 (1.8%)	<0.05
Lack of consolidation	11 (12.2%)	2 (1.8%)	<0.05
Repeated interventions	28 (31.1%)	7 (6.25%)	<0.05
Wound infection	5 (5.6%)	4 (3.6%)	<0.05
Sepsis	3 (3.3%)	-	-
Fatal outcome	6 (6.7%)	1 (0.89%)	<0.05

Based on the data obtained, a statistical analysis was performed according to the criteria of relative risks and odds ratios (OR).

The relative risks for the stage of HIV infection, the number of CD4 lymphocytes, the ratio of CD4/CD8 lymphocytes and the viral load of more than 1 indicate the existence of a relationship between the factors identified and the risk of complications. Of these factors, the stage of HIV infection has the greatest influence ($RR = 3.0$). HIV-infected patients at stages 1–4A of the disease are significantly less susceptible to the risk of complications than patients at stages 4B – 5 (reduction in the relative risk of $RRR 2.0$). At the same time, the number of CD4 lymphocytes less than 300 cells/ μ l, the ratio of CD4/CD8 lymphocytes less than 0.3 and the viral load of more than 5,000 cop / μ l increase the risk of complications in this category of patients to a lesser extent.

The OR parameter allows you to determine not only the statistical significance of the relationship, but also to assess its strength quantitatively. As a result, the analysis of the data obtained for the listed risk factors (stages of HIV infection 4B +, the number of CD4 lymphocytes is less than 300 cells/ μ l, the ratio of CD4/CD8 lymphocytes is less than 0.3 and the viral load is more than 5,000 cop/ μ l, OR is more than 1). This, in turn, indicates a greater probability of risk factors in the group with an unfavorable outcome, that is, the risk of complications in the presence of these factors is greater. Attention is drawn to the OSH stage of HIV infection 4B+ 9.0, for other risk factors, this indicator is in the range of 3.059–3.796. The confidence interval for all four factors does not include 1, that is, the revealed relationship is statistically significant. Statistical analysis of the results of treatment of HIV-infected patients with EAFLBE made it possible to develop a point scale for assessing the risks of surgical treatment of HIV-infected patients.

Each indicator, namely the stage of HIV infection, the number of CD4 lymphocytes, the ratio of CD4/CD8 lymphocytes and the viral load was assessed on a scale from 1 to 4 points, while the stage score was multiplied by 2 due to the strongest correlation according to the OR criterion. The risk of surgical treatment was assessed by the aggregate points. With the sum of points from 1 to 9, the risk of an unfavorable treatment outcome was assessed as low, from 10 to 12 points – medium, 13–14 points – high, 15–18 points – extremely high. The scoring of risk factors are presented in Table. 5.

Table 5
Scoring of risk factors

Stages of HIV infection	Number of CD 4-lim., Cells/ μ l	The ratio of CD 4/CD 8 lymphocytes	Viral load, copies/ml	Score
I – III	More than 500	More than 1	Less than 50	1
IVA	300-500	0.3 to 1	50-5.000	2
IVB – IVC	100-300	0.15 to 0.3	5.000-50.000	3
V	Less than 100	Less than 0.15	More than 50.000	4

Note: HIV – Human Immunodeficiency Virus

Based on the results of the analysis, as well as the literature data indicating the peculiarities of the influence of HIV infection, opportunistic diseases and the side effects of antiretroviral drugs on the processes of bone remodeling, metabolism and trace elements, humoral regulation, nervous system and soft tissue regeneration, an algorithm for determining tactics was developed. and the method of treatment of HIV-infected patients with EAFLBE. It consists of a point scale for assessing the risk of surgical treatment, and also allows for an individual approach when determining the scope of the examination, prescribing consultations of related specialists, choosing the method of intraoperative reduction and osteosynthesis, choosing a metal fixator, as well as the peculiarities of managing patients in the rehabilitation period.

With a low risk of surgical treatment (score from 1 to 9), it is permissible to use the traditional approach to determining the method of intraoperative reduction, the choice of the method of osteosynthesis and the selection of fixators. All options for planned surgical treatment are possible.

With an average risk (from 10 to 12 points), when performing delayed operations for fresh fractures, examination by an infectious disease specialist in the preoperative period is indicated. Intraoperative closed manual and hardware reduction, intramedullary osteosynthesis and MIPO. Open reduction and extra-bone osteosynthesis – only if low-trauma methods of reduction and osteosynthesis are futile or unsuccessful. The selection of metal fixators is carried out taking into account the IPC. All dressings in the postoperative period would be performed in the presence of a doctor. Planned surgical treatment is possible after examination by an infectious disease specialist in order to resolve the issue of correcting ARVT to improve immune status indicators, reduce the effect of ARVT side effects on BMD and metabolism.

Patients with a high risk of surgery (from 13-14 points) upon admission to the hospital for emergency indications are shown a consultation with an infectious disease specialist in order to correct concomitant ARVT and normalize immune status indicators to minimize the effect of therapy on BMD and prescribe etiotropic therapy for a secondary disease. The goal of the treatment is to restore the supporting ability of the limb with the subsequent resolution of the issue of reconstructive operations after the normalization of the immune status indicators. Preference should be given to functional conservative treatment and the imposition of external fixation devices (EFD). If they are futile, delayed surgeries can be performed only with good condition of soft tissues and after regression of edema using low-traumatic methods of reduction and osteosynthesis, using fixators with angular stability (to prevent their aseptic loosening and migration). In the postoperative period, prolonged antibiotic prophylaxis with broad-spectrum drugs for 7 days is indicated. Performing planned surgical treatment is indicated only after long-term treatment with an infectious disease specialist.

With an extremely high risk (more than 15 points), life-saving operations, the imposition of an EFD and the implementation of primary surgical debridement of wounds in open fractures are indicated. After stabilization of the patient's condition, it is recommended to resolve the issue of transferring the patient to the infectious diseases department.

All HIV-infected patients in the postoperative period require careful monitoring of postoperative wounds. At the first signs of complications, secondary surgical treatment of wounds is indicated (with an intraoperative decision on the advisability of imposing a system for treating wounds with negative pressure), performing cultures in order to determine the presence of an infectious agent and its sensitivity to antibiotics, correction of antibiotic therapy based on the results of inoculation.

Patients with a prolonged course of HIV infection (more than 10 years) and taking antiretroviral drugs for 2 years or more, as well as with a high risk of surgical treatment, are shown to perform densitometry followed by an endocrinologist's consultation to determine indications for prescribing therapy with a decrease in BMD in order to prevent further low-energy injuries and aseptic loosening of metal fixators.

Considering the proven negative impact of HIV itself, the causative agents of a number of opportunistic infections, the side effects of ARVT drugs on the functional state of the liver, with a decrease in the level of total protein, anemia, and a decrease in body mass index below 18, the appointment of special enteral nutrition with increased calorie content, protein content, vitamins and omega-3 fatty acids.

All patients are to carry out X-ray control of the damaged area once a year in order to exclude loosening of the metal fixators, and if there are such signs – the decision to remove the metal construction in order to prevent further bone destruction is necessary.

DISCUSSION

Our data indicate that the increased incidence of complications from the postoperative wound in HIV-infected patients is statistically significant compared to patients without HIV infection (53.3% in the main group versus 1.8% in the comparison group, $p < 0,05$), which corresponds to the data obtained by foreign authors [19, 24].

Among 112 patients in the comparison group, there was one case of infiltration (0.89%), one case of hematoma (0.89%) and 2 cases of superficial infection of a postoperative wound (1,78%).

In the main group, 9.2% of cases (7 patients) developed complications from the postoperative wound, infection of the postoperative wound in 2 patients (2.6%). In 3 cases (3.9%), infiltration was formed, in 1 (1.3%) – prolonged discharge of serous fluid, in 1 (1.3%) – there was a discrepancy of the edges of the postoperative wound, in 1 (1.3%) – hematoma formation, in 5 patients (6.6%) – delayed healing of the postoperative wound and in 2 cases (2.6%) – superficial infection of the postoperative wound to the level of subcutaneous fatty tissue. Moreover, the same patient could have a combination of two or three different complications. A similar structure of complications was previously described by foreign authors [20, 21]; nevertheless, the incidence of delayed wound healing is lower than reported in later studies [7, 10].

When signs of development of complications from postoperative wounds appeared in patients, a bacteriological examination of the discharge from the wound was performed to identify the pathogen and determine the sensitivity to antibacterial drugs. In patients of the main group, 2 cases (2.22%) of infection were detected. In the first – *S. aureus*, in the second – *S. epidermidis*. In patients of the comparison group, 2 cases (1.78%) of infection were also noted, in both patients the causative agent was *S. aureus*. In other cultures from postoperative wounds, no microflora growth was found.

In the group of HIV-infected patients, there was a statistically significant difference in the incidence of aseptic loosening and migration of metal fixators, delayed consolidation and the absence of fracture consolidation ($p < 0,05$), which, most likely, may be associated with a decrease in BMD in HIV-infected patients, taking into account the mechanisms described in the literature [1, 8, 16]. From table. 4 it follows that in this group, repeated surgical interventions were performed reliably more often for complications from postoperative wounds and aseptic loosening of metal fixators, as well as violation of fracture consolidation processes ($p < 0,05$).

In HIV-infected patients, sepsis developed in 3 cases. In 2 cases, due to untimely revision of postoperative wounds, which led to the generalization of the infection, and in 1 – not associated with injury and surgery.

Comparison of groups by the number of deaths is incorrect, since most of them (4 out of 6) in the main group occurred for reasons not directly related to the operation (repeated road traffic accident with a fatal outcome on the spot, oncology).

A number of publications also noted the relationship between indicators of the immune status of HIV-infected patients and the results of surgical treatment of fractures [26, 27].

CONCLUSION

Thus, the use of standard algorithms for determining the tactics and method of treatment of extra-articular fractures of the long bones of the extremities in HIV-infected patients leads to a significant number of unsatisfactory treatment results (till 31,1%). For HIV-infected patients, the most typical complications are postoperative wounds, impaired fracture consolidation processes and aseptic loosening of metal fixators, which, without proper attention to them, can lead to the development of infectious complications. Expansion of research in this area with an increase in the number of the observed contingent will make it possible to develop a scientifically based scale for predicting the development of possible postoperative complications in this category of patients.

FINDINGS

1. For HIV-infected patients with extra-articular fractures of the long bones of the extremities, primarily non-infectious complications are characteristic: aseptic loosening and migration of fixators, delayed consolidation of fractures and non-infectious complications from postoperative wounds, which without due attention can lead to the development of an infectious process.

2. There was a statistically significant relationship between the risk of postoperative complications in HIV-infected patients with extra-articular fractures of the long bones of the extremities and HIV infection stage IVB and later, the number of CD4 lymphocytes less than 300 cells / μL , the ratio of CD4 / CD8 lymphocytes less than 0,3, viral load over 5,000 cop / ml.

3. The algorithm for determining the tactics and method of treatment of extra-articular fractures of the long bones of the extremities in HIV-infected patients, developed on the basis of the conducted statistical analysis, allows an objective assessment of the risk of postoperative complications in points and to develop an individual approach to the choice of a treatment regimen, taking into account the peculiarities of the effect of HIV infection and antiretroviral therapy on patient's organism.

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