

Research Article

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Accompanying Therapy in the Surgical Treatment of Pathological Fractures of the Long Bones and Chronic Fractures of the Trochanteric Region

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ABSTRACT The article presents a study of palliative surgical treatment of patients with pathological fractures of the long bones and chronic trochanteric fractures. Those patients are not indicated for special oncological treatment. Therefore, the article does not provide staging of malignant neoplasms. The surgical treatment was aimed at improving the quality of life of palliative patients, and accompanying therapy in the form of the Altaicae extract adaptogen and the neutral anolyte led in our study to an increase in the effectiveness of surgical treatment of such a severe contingent of patients.

INTRODUCTION According to domestic and foreign literature, the number of oncological diseases in young and old people is growing. There is a trend to neglecting the disease and late visits to doctors. Almost all types of cancer of various localization and other malignant tumors metastasize to the bones. An increase in the number of pathological (metastatic) fractures of the trochanteric region and the long bones was also noted. Surgical treatment of patients with such a severe type of fractures leads to an aggravation of the already existing immunodeficiency and, as a rule, creates the prerequisites for the occurrence of infectious complications in the postoperative period. The choice of a conservative method of treatment often does not justify itself as well, it leads to diagnostic and therapeutic errors, and in the future – to chronic pathological fractures.

AIM To improve the effectiveness of surgical treatment and the quality of life of palliative patients with pathological (metastatic) fractures of the long bones and chronic trochanteric fractures using original authors' accompanying therapy.

MATERIAL AND METHODS 177 patients were examined and divided into two groups - the main and the comparison groups. 72 patients were included in the main group, and 105 patients - in the comparison group. There were 110 men and 67 women. The patient age ranged from 35 to 90 years. The main group received surgical treatment with the use of new accompanying therapy along with the basic one, and the comparison group received only surgical treatment and basic therapy.

RESULTS In the main group patients with chronic pathological fractures of the trochanteric region, who underwent endoprosthetic replacement, osteosynthesis, a new method of surgical treatment of metastatic fractures of the long bones and the authors' accompanying therapy, the effectiveness of surgical treatment increased significantly compared to the comparison group. As a result, most of the unwanted symptoms disappeared, time spent in hospital decreased, the psycho-emotional status and immunity improved, the functional state of the body was optimized, and the quality of life improved.

CONCLUSION The use of new accompanying therapy, the authors' method of surgical treatment of patients with pathological (metastatic) fractures of the long bones, chronic fractures of the trochanteric region allows us to successfully and effectively operate on such severe patients and perform a fast track surgery program in the early postoperative period.

Keywords: arthroplasty, osteosynthesis, Altai extract adaptogen, ANK neutral anolyte

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During surgical treatment, 70% of patients with chronic pathological (metastatic) fractures of the trochanteric region and long bones in the presence of immunodeficiency develop postoperative pyoinflammatory processes [1–4]. To increase the effectiveness of the surgical treatment, an accompanying therapy was developed that allows us to stop the manifestation of surgical stress and trauma, as well as activate the psycho-emotional status and recovery processes of the patient's body, remove unwanted symptoms and thereby improve the patient's quality of life. This is the relevance of surgical treatment in such a severe contingent of patients. From the 1950s–1970s of the 20th century to the present, studies of adaptogens and immunoregulators of natural origin have been developed in the USSR and Russia, including their use in surgery and oncology [5, 6].

The pharmacological properties of adaptogens make it possible, if necessary, to use them in combination with any means of symptomatic therapy, they can also be safely used for a long time by practically healthy people in preparation for intensive professional activity, to increase efficiency, reduce consequences of various types of trauma (and planned surgical interventions), accelerate the recovery of disturbed structures and functions. As a result of adaptive pharmacotherapy, a high potential of reparative and stress-limiting systems which prevent and limit further damaging effects of physical, chemical and biological factors is initially formed. The influence of an adaptogen on the key mechanisms of adaptation is determined, first of all, by the processes of increasing and coordinating the information and energy potential of the body, adaptive protein synthesis, the activity of antioxidant systems, restoring neuroendocrine regulation, immunity and anti-infective resistance of the body [2, 5, 7].

The direct participation of natural bioregulators in the considered processes justifies the targeted use of fast-acting adaptogens as the main or additional means for adaptive prevention and correction of various stressful pathological conditions at the molecular genetic level. Clinical observations of patients for more than 20 years have confirmed the complex protective and restorative effect of adaptogens [2, 5, 8].

It is known that the main antioxidant defense enzymes of the body are catalase, peroxidase, and superoxide dismutase which are significantly impaired in surgical trauma [9, 13].

Domestic scientists have proposed a unique method of pharmacological stimulation of the antioxidant defense mechanisms of the body. Progressive pharmacological agents are highly effective in experimental and practical medicine as geroprotectors, exhibiting the properties of anticarcinogens, radioprotectors and biomodulating substances.

The mechanism of action of such morphological agents is based on the effect of water and macromolecules on the redox potential. Now new methods have been developed for obtaining substances with the required indicators of redox potential, which are harmless to the body and are based on ordinary water - these are ion-activated aqueous agents or electrochemically activated aqueous agents [6, 10, 12].

An urgent task at present is the program of accelerated recovery of surgical patients (fast track surgery) from the standpoint of evidence-based medicine and a multidisciplinary approach. This is especially important for elderly patients, for whom a long hospital stay brings enormous psychoemotional stress, which leads to immunosuppression followed by infectious complications [1, 2, 11].

Aim of research: To improve the efficiency of surgical treatment and the quality of life of palliative patients with pathological (metastatic) fractures of the long bones and chronic fractures of the trochanteric region using original authors' accompanying therapy.

MATERIAL AND METHODS

177 patients were examined and divided into two groups — the main group and the comparison group. The main group included 72 patients, the comparison group - 105. There were 110 men and 67 women. The age of patients was from 35 to 90 years. The main group received surgical treatment with the use of the new accompanying therapy along with the basic one, and the comparison group received only surgical treatment and basic therapy. Surgical treatment of these patients was carried out from 2019 to 2021 at the Department No. 1 of the N.N. Priorov National Medical Research Center of Traumatology and Orthopedics and the Department No. 2 for Traumatology and Orthopedics of the S.S. Yudin City Clinical Hospital. Statistical processing of the results was carried out using standard methods of variation statistics (Student's t-test, Fisher's exact test with Yates' Correction, Spearman's correlation coefficient) with the Statistika software package. Differences with a probability of at least 95% were considered significant; $p < 0.05$.

The Tables 1 and 2 present the diagnoses and types of surgical procedures in the main and comparison groups.

Table 1

Diagnoses and types of surgical procedures

Diagnosis	Type of surgery	Number of patients			
		main group		comparison group	
		n	%	n	%
Pathological (metastatic) fractures of the long bones	Metal and polymer individual express endoprosthetic replacement of the diaphysis of the long bones	40	55,6	73	69,5
Chronic pathological fractures of the trochanteric region	Endoprosthesis, osteosynthesis	32	44,4	32	30,5

For enhanced recovery after surgery (fast-track surgery) of patients with pathological (metastatic) fractures of the long bones, who underwent intraoperative metal and polymer individual express endoprosthetic replacement, and patients with chronic pathological fractures of the trochanteric region, who underwent endoprosthesis or osteosynthesis, an accompanying therapy was used in the form of Altai extract adaptogen administration (registration No. 000065/01 dated March 21, 2007) in combination with ion-activated neutral anolyte solution application (ANK - registration No. LS-002150, dated March 21, 2012) - an antiseptic and antioxidant.

The technique was as follows: The day before surgery, the Altai extract adaptogen was taken in doses of 15 ml, diluted in 30 ml of the ion-activated aqueous solution (pH=7.4); redox potential (RP)=+750 mV. After removal of the tumor, the surgical wound was treated with neutral anolyte (pH=7.4; RP=+750 mV), in the amount of 1000 ml. The duration of neutral anolyte treatment of the postoperative wound is 3 minutes. Within 10 days after surgery, the patients received the Altai extract adaptogen according to the above scheme [5, 10].

OUTCOMES AND DISCUSSION

The treatment outcomes were determined by immunological, functional indicators, quality of life and survival. A clear positive picture of the normalization of the above parameters was obtained. Rapid recovery after fast track surgery with the supportive therapy was primarily assessed by the elimination of unwanted symptoms and the length of hospital stay in the early postoperative period.

The functional state - the patient's motor activity - was assessed according to the following criteria: "good" - the patient moves at home without additional support, uses a stick on the street, no pain syndrome, the range of motion in the joint is at least 50–70% of the norm; "satisfactory" - the patient walks with a cane or one crutch, rarely experiences pain, can serve himself, range of motion is at least 30-50% of the norm; "poor" - a pronounced limitation of movements, the patient walks with the help of crutches, needs extraneous care.

Tables 3, 4, 5 show the effectiveness of the accompanying restorative therapy in the form of the Altai extract adaptogen and the neutral anolyte in the surgical treatment of palliative patients with pathological fractures of the long bones and chronic fractures of the trochanteric region of the femur, which were evaluated by the following immunological parameters: cellular immunity, humoral immunity, phagocytosis.

Table 2

The content of populations and subpopulations of lymphocytes before and after treatment

Parameters	Reference ranges (in %, M \pm 1.5 sigma shift)	Main Group, % content		p	Comparison group, % content		p
		Before treatment	After treatment		Before treatment	After treatment	
CD3	62–74	51,7 \pm 2,0	67,1 \pm 2,3	<0,05	50,3 \pm 1,9	53,3 \pm 3,1	<0,05
CD4	36–47	29,3 \pm 1,8	45,6 \pm 2,1	0,001	27,5 \pm 2,3	32,2 \pm 2,7	0,001
CD8	26–31	23,9 \pm 0,7	29,7 \pm 0,8	<0,05	24,2 \pm 1,5	23,5 \pm 0,9	<0,05
CD4/CD8	1,6–1,9	1,3 \pm 0,2	1,8 \pm 0,3	<0,05	1,2 \pm 0,3	1,4 \pm 0,2	0,021
CD20	5–15	2,4 \pm 0,4	10,0 \pm 2,3	<0,05	3,5 \pm 1,3	8,4 \pm 2,1	0,043
CD16	9–20	8,3 \pm 0,5	19,4 \pm 2,2	0,01	7,3 \pm 1,2	15,8 \pm 1,0	0,007
CD56	0,1–5	7,2 \pm 0,2	5,4 \pm 2,8	<0,05	8,3 \pm 1,5	7,8 \pm 0,7	<0,05

Note: the table shows the values of M \pm m, p – statistically significant differences when compared with the values of indicators in the group of healthy individuals (normal values)

As a result of the Altai extract adaptogen administration and neutral anolyte application, the normalization of almost all initially reduced parameters of cellular immunity was noted: T-, B-, NK cells, T-helpers, T-killers; in the comparison group, only the initially reduced level of B-lymphocytes and natural killers normalized.

The parameters of humoral immunity before and after treatment in the experimental and comparison groups are presented in Table 3.

Table 3

The content of three classes of immunoglobulins, circulating immune complexes (CICs) before and after treatment (humoral immunity)

Parameters	Norm, M \pm 1.5 sigma shift)	Main group		Comparison group	
		Before treatment	After treatment	Before treatment	After treatment
IgA	0,9–4,5	2,1 \pm 0,8	4,3 \pm 1,4	1,8 \pm 0,1	2,8 \pm 1,3
IgM	0,6–2,5	1,7 \pm 0,1	0,9 \pm 1,2	1,3 \pm 2,7	1,4 \pm 3,1
IgG	8,0–18,0	11,3 \pm 0,7	10,8 \pm 2,4	12,1 \pm 1,3	14,5 \pm 0,3
CICs, medium molecular	55–60	28,1 \pm 10	31,4 \pm 10	31,2 \pm 18,0	34,2 \pm 15

Note: reliability of differences in indicators (p<0.05)

The accompanying therapy facilitated a significant improvement in humoral immunity in the main group as compared to the comparison group.

The phagocytic component of innate immunity was assessed before and after treatment (Table 4).

Table 4

Indicators of phagocytosis before and after treatment

Parameters	Norm, M \pm 1.5 sigma shift)	Main group		Comparison group	
		Before treatment	After treatment	Before treatment	After treatment
Content of phagocytic cells, %	65–88	62,1 \pm 2,2	70,1 \pm 1,5	63,4 \pm 1,8	55,3 \pm 1,4
Phagocytic index	2,3–3	1,87 \pm 0,7	2,8 \pm 0,4	1,9 \pm 1,5	2,2 \pm 2,7
Completion of phagocytosis	\geq 1	0,85 \pm 0,01	0,98 \pm 0,05	0,78 \pm 0,03	0,85 \pm 0,08

Note: reliability of differences in indicators (p<0.05)

As follows from Table 4, a decrease in all parameters of phagocytosis was noted before treatment (compared to the norm, $p < 0.05$) in the examined patients; after treatment, all indicators of phagocytosis returned to normal in the main group, in the comparison group (without the use of immunomodulators) - phagocytosis was depressed.

Thus, with the use of the accompanying therapy, normalization of the parameters of CD8 lymphocytes was observed, the number of CD56 (the archetypal phenotypic marker of natural killer cells), lymphocytes (a marker of readiness for apoptosis), increased (Table 2). The parameters of humoral immunity were restored (Table 3). The parameter of medium molecular circulating immune complexes (CICs) returned to normal in the main group.

On the 7-10th day after the start of the accompanying therapy, the functional significance of neutrophilic granulocytes was optimized; as a result, there was an increase and normalization of the completion of phagocytosis (Table 2) in the main group. In the comparison group, the functional picture of phagocytosis of neutral granulocytes did not return to normal. When studying the parameters of the immune status, a decrease in T-killers was observed in both groups. On the 10th day, the mass of killer cells increased and at the same time their normalization with the CD56 parameter occurred in the main group.

This was not observed in the comparison group.

Thus, the differences in the mass of killers and CD56 parameters that produce restorative cytokines were increased in the comparison group and returned to normal in the main group.

Apoptosis of cells in the form of their elimination was practically not active in the comparison group compared with the main group, where immunocorrection was applied.

The active function of phagocytosis of neutrophilic granulocytes in the comparison group, where accompanying therapy was not used, did not normalize (Table 4).

Correction of recovery processes using the Altai extract adaptogen administration and neutral anolyte application normalized the immunological parameters presented in Table. 2. The time of hospital stay was significantly reduced, it amounted to 10.5 ± 2.6 bed-days, and in the comparison group - 28.7 ± 4.3 bed-days, which indicates the implementation of the fast track surgery (the accelerated recovery program) in patients of the main group. There were no postoperative complications in the form of wound suppuration in the main group, while in the comparison group it occurred in 45 patients (25.4%).

The data given in Table 5 indicate that Altai extract adaptogen administration and neutral anolyte application increased the bactericidal, phagocytic and chemiluminescent activity of leukocytes, which stimulated the formation of antibodies (the level of IgG immunoglobulin increased). The level of IgA immunoglobulin increased, which indicates continued healing of the surgical wound and a moderate inflammatory process. In all the patients of the main group, the postoperative wound healed by primary intention. In the comparison group, 45 patients (25.4%) had postoperative infectious complications in the form of suppuration of the surgical wound which healed by secondary intention within 1–2 months. An increase in temperature in patients of the main group up to 37.5°C was observed within 1–3 days after surgery, with a gradual normalization by the 5th day. In the patients of the comparison group, the temperature returned to normal within 10–12 days, and in some of them - within 2–3 weeks.

The recovery period in patients of the main group proceeded without deviations and complications. The patients began to move on the 2nd day after surgery and were discharged from hospital on the 10th–11th day. The average bed-day was 10.5 ± 2.6 ($p < 0.05$). The patients from the comparison group were discharged on days 29–35 after surgery. The average bed-day in the comparison group was 28.7 ± 4.3 ($p < 0.05$). Thus, the additional prescription of the Altai extract adaptogen in combination with neutral anolyte made it possible to reduce the duration of treatment by an average of 2 weeks, prevent possible postoperative complications, and increase the activity of patients.

The quality of life after surgical treatment in the main and comparison groups was assessed in points (Tables 5)

Table 5

Dynamics of the quality of life during surgical treatment with the use of accompanying therapy

Indicators	Before treatment (M±m), point		After treatment (M±m), point	
	Before treatment	After treatment	Before treatment	After treatment
Energy	60,7±2,3	68,8±1,7	56,8±1,7	60,1±1,3
Pain	84,3±2,5	17,5±2,1	78,3±1,1	79,1±0,8
Emotional reaction	45,3±1,4	62,7±0,8	48,2±1,9	48,5±1,4
Sleeping	43,2±2,1	68,3±2,9	40,4±0,5	42,3±0,5
Physical activity	10,5±2,8	98,4±1,7	32,3±2,7	37,2±1,3

Note: reliability of differences in indicators ($p < 0.05$)

The quality of life in the main group increased by $87.9 \pm 2.4\%$, and in the comparison group - by $23.7 \pm 1.5\%$, which indicates the optimization of surgical treatment of patients with severe fractures.

When evaluating the immediate functional results, intensity, nature and regularity of pain in the area of endoprosthesis replacement, the possibility of active movements in the operated and nearby joints, the amplitude of passive movements and motor activity of patients were taken into account. For this purpose, the immediate functional results were examined in patients of the main and comparison groups with chronic pathological fractures of the trochanteric region, metastatic fractures of the long bones after surgical treatment in combination with the new accompanying therapy and without it (Table 6)

Table 6

Immediate functional results in the early postoperative period

Outcome	Number of clinical observations, %	
	Main group	Comparison group
Good	118 (95, 93)	75 (78, 13)
Satisfactory	5 (4, 07)	21 (21, 87)
Total:	123 (100)	96 (100)

In the comparison group, good results were obtained in 78.13% of cases, and satisfactory results were obtained in 21.87% of cases. In the main group, after a course of fast-acting Altai extract immunomodulator and adaptogen administration in combination with neutral anolyte application, good results (95.93%) were obtained in a larger number of patients, and a satisfactory result was observed only in 4.07% of the patients. This indicates a significant immunocorrective and adaptive therapeutic and restorative effect of the Altai extract in combination with neutral anolyte, which manifests itself during the period of surgical trauma.

A follow-up examination of both groups of palliative patients showed that the 3-year survival rate after surgical treatment with the new accompanying therapy was 25% in the main group, and 11% in the comparison group, respectively.

After salvage surgeries for chronic pathological fractures of the trochanteric region and metastatic fractures of the long bones in palliative patients, the probability of cure is low, but the possibilities of preserving limb functions, self-care and feasible work are quite real. Sometimes even for months or years. Early activation of patients can significantly reduce the use of painkillers. In addition, the psycho-emotional status of patients is optimized. After salvage surgeries, as proven by clinical practice, palliative patients believe in the favorable nature of the process and are more optimistic about their future life.

The following are clinical examples.

Patient P., aged 41, was admitted to the clinic because of an old pathological trochanteric fracture of the right femur due to bone metastases of right breast cancer. The patient was forced to comply with bed rest. A total endoprosthesis replacement of the right hip joint with the Wagner self-locking stem was performed using the new

accompanying therapy. The postoperative period proceeded without complications. The patient was active, optimistic, after 3 weeks she began to walk with crutches. She was discharged from hospital 7 days after surgery. The patient was periodically examined. The mental status of the patient improved significantly. She performed moderate physical work around the house, led an active lifestyle. She died 2.5 years later from the underlying disease.

Patient V., 83 years old, was admitted to the clinic because of an old pathological pertrochanteric fracture of the left femur due to bone metastases of thyroid cancer. Osteosynthesis with gamma nail was performed using the new accompanying therapy. The postoperative wound healed by primary intention. The patient recovered quickly and was discharged from hospital on the 6th day. The patient was followed-up after discharge at the place of residence for 3 years.

Patient Sh., 55 years old, suffering from left breast cancer, was admitted to the clinic because of a metastatic fracture of the middle third of the left humerus. She underwent resection of the upper third of the left humerus with metal and polymer individual express endoprosthetic replacement simultaneously followed by the new accompanying therapy.

The postoperative period was uneventful, the state of health was good. Movement in the operated left upper limb recovered to a satisfactory extent. When examined after 3 years and 2 months, movements in the elbow joint without restrictions, in the shoulder joint - abduction was possible up to an angle of 45°, movements in sagittal plane without restrictions. The patient performed work that did not require heavy physical effort.

Patient U., aged 75, was admitted to the clinic because of an old pathological (metastatic) pertrochanteric fracture of the right femur due to the spread of metastases in the bone system from cancer of the left kidney. In general healthcare, he unsuccessfully underwent a course of conservative treatment for 6 months. The patient developed hypodynamic complications in the form of bedsores in the area of the heel and sacrum, and as a result he had to be constantly in the supine position.

3 days before surgical treatment, the patient was prescribed the Altai extract adaptogen in combination with neutral anolyte. The metastatic tumor of the proximal femur was removed within healthy tissues. The surgical wound was treated with the neutral anolyte according to the above scheme, and total right hip arthroplasty using an oncological prosthesis with a long stem was performed. The wound healed by first intention. In the postoperative period and until discharge from hospital, the patient continued to receive the new authors' accompanying therapy.

Similar positive outcomes of intraoperative metal and polymer individual express endoprosthetic replacement and Altai extract adaptogen administration in combination with neutral anolyte application were obtained in patients with other localizations of bone metastases, as well as with pathological fractures. In all operated patients, bone pain disappeared, and the "degree of activity" increased.

All the patients regained the ability to independently serve themselves and do housework. And 16 patients of working age returned to their previous work, including physical one. All of them significantly improved their psycho-emotional state.

The treatment regimen of Altai extract adaptogen administration in combination with neutral anolyte application reduced the postoperative period by 1.5–2 times, contributed to a faster recovery of the immune status, the functional state of the body, optimizing the psycho-emotional status, and reducing the number of postoperative infectious complications. The quality of life improved significantly.

We present an observation of the early postoperative period after unipolar proximal endoprosthetic replacement of the right hip joint in patient U., 75 years old, for an old pathological (metastatic) pertrochanteric fracture of the right femur (Fig. 1–3).



Fig. 1. Patient U., 75 years old. The first day after surgery in the intensive care unit



Fig. 2. X-ray of the right hip joint before surgery. An old pathological pertrochanteric fracture of the right femur is visible



Fig. 3. X-ray of the right hip joint after arthroplasty of the right hip joint by an oncological endoprosthesis

In the preoperative period, all the patients had severe pain syndrome. In the postoperative period, with Altai extract administration in combination with neutral anolyte application in the main group, pain in the operated organ was much less common (only after a long walk). Most patients rated their quality of life as good.

The duration of rehabilitation, which depend on the volume and type of surgery, patients' age, their psychological state, the beginning of activity in the postoperative period and the prescription of adaptive and restorative immunocorrective therapy based on Altai extract adaptogen in combination with neutral anolyte, play an important role in improving the quality of patient life.

CONCLUSION

Thus, organ-sparing surgical treatment in palliative patients with chronic pathological fractures of the trochanteric region and metastatic fractures of long bones using arthroplasty, osteosynthesis, intraoperative metal and polymer individual express endoprosthetic replacement with the new accompanying therapy in the form of Altai extract adaptogen administration in combination with neutral anolyte application is an effective medical aid.

As a result, the effectiveness of surgical treatment of such a severe contingent of patients increased, which led to rapid rehabilitation in the early postoperative period, improved the patients' quality of life, and significantly reduced the time spent in hospital.

This method of surgical treatment can be successfully applied in practical medicine, in particular: surgery, traumatology and orthopedics, oncology in patients with pathological bone fractures.

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