Hematological indications for the treatment of fractures of tubular bones in dogs by osteosynthesis

S.A. Khaidarova	Basic doctoral student, scientific adviser candidate of veterinary sciences.
B.D. Narzieva	associate professor Samarkand Institute of Veterinary Medicine

ABSTRACT

The paper presents the results of studies to determine the morphological and biochemical parameters in the blood of dogs with fractures of tubular bones during treatment according to a special treatment regimen after intramedullary osteosynthesis.

Keywords: Tubular bones, intramedullary osteosynthesis, hemoglobin, erythrocytes, leukocytes, erythrocyte sedimentation rate (ESR), alkaline phosphatase (AP), bitter phosphatase (BPh), total calcium, inorganic phosphorus.

Relevance of the topic. Determination of phosphatase activity has an important diagnostic and prognostic value in the healing of fractures and mineral metabolism in animals [1]. In bone fractures, changes in bone tissue and resorption volume are observed in violation of skeletal homeostasis [2, 3, 4], this conclusion is most important for determining the activity of AP, BP and the concentration of a number of electrolytes (total calcium, inorganic phosphorus) [5]. Undoubtedly, there is a close relationship between the formation of bone tissue and the synthesis of blood cells, so it is natural to assume that indicators of the dynamics of the composition of blood cells can be used to characterize the intensity of reparative osteogenesis. This methodological approach makes it possible to understand the features of hematological parameters during bone regeneration during interstitial osteosynthesis [6].

Purpose of the study. Intramedullary osteosynthesis of dogs with fractures of long bones belonging to the population, and the study of the state of blood parameters during their subsequent treatment according to a special scheme.

Materials and research methods. The experiments were carried out on 18 dogs with fractures of tubular bones of various etiology, belonging to the population of the Samarkand region and the city. The dogs were divided into groups of 2 experimental and 1 control (6 animals each).

Dogs of the first experimental group were treated according to a special scheme after intramedullary osteosynthesis: for 10 days, lincomycin was administered 1.0 ml intramuscularly 2 times, calcium gluconate 1 tablet (0.5 g) 2 times a day orally for 25 days, for 15 days, the mummy preparation is dissolved in 1 tablet (0.2 g), mixed with 5 ml of water and taken orally 2 times a day, and also for 15 days Aquadetrim (vitamin D_3) 15,000 IU, 3 drops 1 time per day, mixed with food.

For dogs of the second experimental group: lincomycin 1.0 ml 2 times intramuscularly for 10 days, calcium gluconate

1 tablet (0.5 g) 2 times a day orally for 25 days, osteogenon 0.85 g $^1/_2$ tablets 2 times a day orally for 15 days, as well as Aquadetrim (vitamin D_3) 15,000 IU were given 5 drops 1 time, mixed with food.

Dogs of the control group: lincomycin 1.0 ml 2 times intramuscularly for 10 days, calcium gluconate 1 tablet (0.5 g) 2 times for 25 days and Aquadetrim (vitamin D3) 15000 IU for 15 days 1 time 5 drops per day were added to the feed.

The dogs underwent regular clinical examinations. Before surgery, blood samples were taken from a vein in dogs and morpho-biochemical studies were performed once every 10 days in the postoperative period. The number of erythrocytes and leukocytes in the blood was determined under a microscope in the Goryaev counting network, ESR on the Panchenkov device, the amount of hemoglobin, calcium, inorganic phosphorus, alkaline and bitter phosphatase in the blood was accurately determined on the CYANSmart CY009 spectrophotometer (China) by the colorimetric method.

Research results. In all three groups, in dogs, morphological blood parameters before surgery were within the physiological norm. Analysis of the results of the study showed that the average amount of hemoglobin in the blood of dogs of the 1st group before surgery was 106.02±6.66 g/l; in the 2nd group 115.30±3.04 g/l; in group 3 it was 110.13±6.93 g/l (p<0.05) (table 1). On the 10th day of treatment, the amount of hemoglobin in the blood slightly decreased in the 1st and 2nd groups compared to the baseline (99.0±6.25 g/l in the 1st group; 105.98±6.59 g /l in the 2nd group, p<0.05). In dogs of the control group, the hemoglobin level was significantly lower than the initial level (93.32±3.40 g/l; p<0.05). In the postoperative period, that is, on the 20th day of treatment, it was found that the amount of hemoglobin in the blood increased in dogs of the 1st and 2nd experimental groups compared with the 10th day (109.08 ± 5.30 g /l in the 1st group, 108.22 ± 6.79 g/l in the 2nd group (p<0.05)). The hemoglobin level decreased in the control group compared to the 10th day (93.79±1.60 g/l (r<0.05). By the 30th day of treatment, the hemoglobin level in dogs in the first and second experimental groups and in the control group was higher than on the 20th day (113.28±5.24 g/l in the 1st group; 108.85± 6.56 g/l in the 2nd group, 95.27±1.82 g/l in the 3rd group - (p<0.05).

Table 1

Dynamics of hemoglobin in the blood (g/l)

Groups	Days of treatment			
	Before surgery	10 days	20 days	30 days
Experiment I	106,02±6,66	99,0±6,25	109,08±5,30	113,28±5,24
Experiment II	115,30±3,04	105,98±6,59	108,22±6,79	108,85±6,56
Control	110,13±6,93	93,32±3,40	93,79±1,60	95,27±1,82

The number of erythrocytes in the blood of dogs (table 2) before surgery was 4.66±0.43 million/μl in the 1st experimental group, 4.97±0.12 million/μl in the 2nd experimental group and 5.00± 0.45 million/μl in dogs in the control group. On the 10th day after the operation, the number of erythrocytes in the blood of dogs significantly decreased from the initial level in all three groups (4.17±0.28 million/μl in the 1st group, 4.47±0.28 million/μl in the 2nd group). -th group, 4.15±0.42 million/μl in the 3rd group (r<0.05)). A decrease in these indicators indicates a metabolic disorder in bone fractures and a decrease in the protective reaction in the body.

By the 20th day of the experiment, an increase in the number of erythrocytes in the blood of dogs of the 1st and 2nd experimental groups was observed (4.53±0.29; 4.59±0.26 million/μl (p<0.05), respectively, and in the control group there was a decrease in this indicator 3.89±0.54 million/μl (p<0.05)). On the 30th day of the experiment, the number of erythrocytes turned out to be higher than on the 20th day, that is, 5.02 ± 0.32 million/μL in the 1st group, 4.85 ± 0.15 million/μL in the 2nd group and 4.11±0.53 million/μl in the 3rd group (p<0.05).

Table 2

Dynamics of the number of erythrocytes in the blood (million / μl)

Groups	Days of treatment			
	Before surgery	10 days	20 days	30 days
Experiment I	4,66±0,43	4,17±0,28	4,53±0,29	5,02±0,32
Experiment II	4,97±0,12	4,47±0,28	4,59±0,26	4,85±0,15
Control	5,00±0,45	4,15±0,42	3,89±0,54	4,11±0,53

If the number of leukocytes in the blood of dogs in all three groups before the operation was within the normal range (respectively 8.10±1.22; 6.82±1.04; 6.34±0.40 thousand/μl (p<0, 05), then in the next 10 days the number of leukocytes in the blood was within the normal range, but slightly increased from the baseline (Table 3) (in the 1st group, respectively, 9.83±0.49; 9.62±1.21; 11 .63±0.76 μg/μl (p<0.05). This indicates that the inflammatory process has begun. On the 20th day of the experiment, the number of leukocytes in the blood of dogs of the 1st experimental group returned to normal (7.55±0.72 thousand/μl (p<0.05), and in the 2nd experimental group the number of leukocytes decreased compared to day 10 (8.98±0.64 thousand/μl (p<0.05).

In dogs of the control group, a sharp increase in the number of leukocytes was observed on the 20th day of the experiment (15.42±1.85 thousand/μl (p<0.05). This condition is characterized by the presence of purulent inflammation at the wound site, which occupies the highest level of negative leukocyte dynamics during the experiment.

The number of leukocytes decreased on the 30th day after the operation in dogs of experimental groups 1 and 2 compared with the 20th day (6.86 ± 0.23; 8.59 ± 0.72 thousand/μl (p<0.05). In the control group, a decrease in the number of leukocytes was also observed (9.15±0.97 thousand/μl (p<0.05), but it was lower than the initial values.

Table 3

Dynamics of the number of leukocytes in the blood (thousand / μl)

Groups	Days of treatment			
	Before surgery	10 days	20 days	30 days
Experiment I	8,10±1,22	9,83±0,49	7,55±0,72	6,86±0,23
Experiment II	6,82±1,04	9,62±1,21	8,98±0,64	8,59±0,72
Control	6,34±0,40	11,63±0,76	15,42±1,85	9,15±0,97

1. All dogs in the experiment had an erythrocyte sedimentation rate (ESR) in the preoperative norm (2.83±0.87 mm/s in the 1st group; 4.67±2.02 mm/s in the 2nd group; 2.50±0.54 mm/s in the 3rd group). By the 10th day after the operation, this indicator increased in all three groups (10.67±1.54 mm/s in the 1st group; 11.17±2.16 mm/s in the 2nd group; 14.67±1.50 mm/s in the 3rd group). On the 20th day of the experiment, the ESR in dogs of the 1st experimental group was faster than on the 10th day (6.67±2.25 mm/s). However, in dogs of the experimental and control group 2 ESR was still slower (12.17 ± 1.29 mm/s in group 2; 12.50 ± 2.20 mm/s in the control group). On the 30th day, ESR returned to normal in the 1st experimental group (3.50±0.62 mm/s), but the ESR did not return to the initial level in the 2nd experimental and control groups (7.33±1.13 mm /s in the 2nd experimental group, 6.67±1.23 mm/s in the control group). Inflammation after operations

and injuries is a clear sign of the development of events, and the ESR level serves. In both groups, its level increased sharply (Table 4).

Table 4

ESR dynamics in blood (mm/s)

Groups	Days of treatment			
	Before surgery	10 days	20 days	30 days
Experiment I	2,83±0,87	10,67±1,54	6,67±2,25	3,50±0,62
Experiment II	4,67±2,02	11,17±2,16	12,17±1,29	7,33±1,13
Control	2,50±0,54	14,67±1,50	12,50±2,20	6,67±1,23

The level of calcium in the blood of all dogs in the experiment averaged 2.80 ± 0.12 mmol/l, respectively, in the 1st group before surgery; in the 2nd group - 2.73±0.31 mmol/l; in the 3rd group - 2.92±0.02 mmol/l; ($p<0.05$). On the 10th day of treatment, the amount of calcium in the blood in the 1st group was significantly higher than the previous time. An increase was also observed in the 2nd and control groups (4.39±0.55; 3.38±0.22 and 3.17±0.37 mmol/l; $p<0.05$, respectively). This condition can be explained by the fact that there is a process of bone formation at the site of the fracture. By the 20th day of postoperative treatment, the level of total calcium in the blood was higher in dogs of the 1st experimental group than on the 10th day of treatment (4.51±0.57 mmol/l), and decreased in the 2nd experimental group compared with the 10th day (3.07±0.31 mmol/l). The level of calcium in dogs of the control group was 2.83±0.18 mmol/l on the 20th day; ($p<0.05$) and turned out to be less than on the 10th day. By the 30th day of treatment, the dogs of the first experimental group showed an increase in total serum calcium and a decrease (3.73±0.24 mmol/l) compared with the 20th day ($p<0.05$). This is due to the deposition of calcium ions in the organic matrix at the fracture site. In dogs of the 2nd experimental and control groups, compared with the 20th day, an increase in the level of calcium was observed (3.93±0.06; 3.22±0.10 mmol/l; $p<0.05$). This indicates that the formation of the bone marrow continues in dogs of the 2nd experimental and control groups.

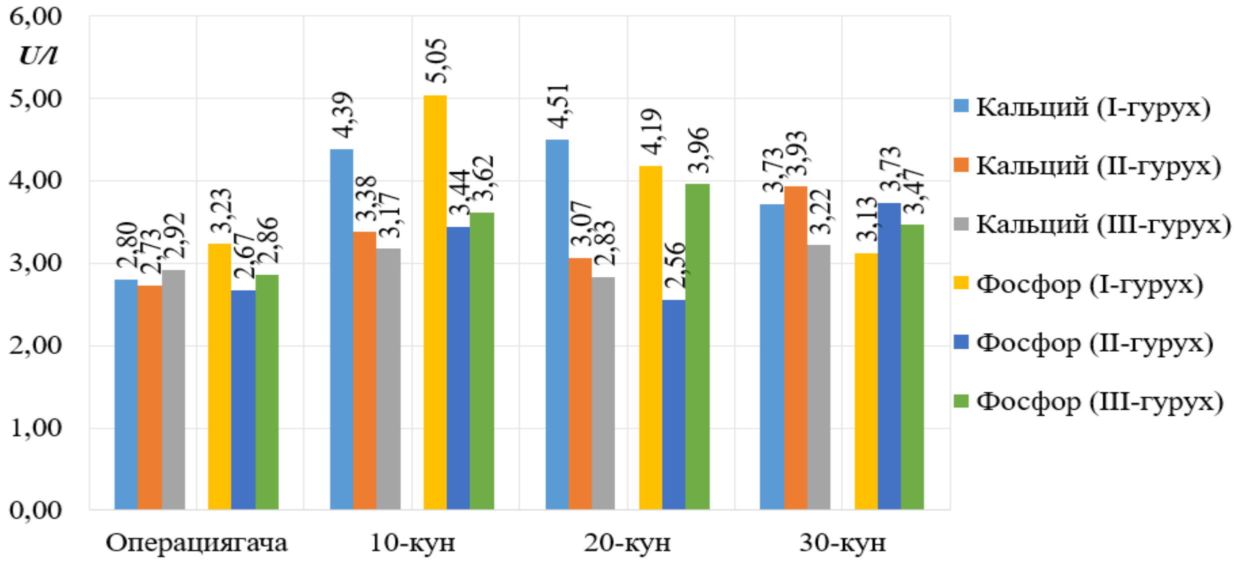

Figure 1. **Dynamics of calcium and inorganic phosphorus in blood serum**

According to the results of the experiments, the amount of inorganic phosphorus in the blood of dogs of the 1st, 2nd experimental and control groups before surgery was 3.23±0.40; 2.67 ± 0.36; 2.86±0.06 mmol/l (r<0.05), respectively, and on the 10th day of the experiment, the amount of inorganic phosphorus in the blood of dogs of the 1st experimental group was 5.05±0.57 mmol/l compared with the initial state, in dogs of the 2nd experimental group it increased by 3.44±0.33 mmol/l ($p<0.05$). An increase in inorganic phosphorus relative to the initial state (3.62±0.17 mmol/l) was also observed in the control group ($p<0.05$). On the 20th day of treatment, there was a significant decrease in the amount of inorganic phosphorus in the blood of dogs of the 1st and 2nd experimental groups (4.19±0.65; 2.56±0.44 mmol/l), and in the control group an increase compared with day 10 (3.96 ± 0.48 mmol/l $p<0.05$). By the 30th day of treatment, it was found that the amount of inorganic phosphorus in the blood of dogs in the 1st experimental and control groups decreased, that is, by 3.13±0.32 mmol/l in the 1st experimental group and by 3.47± 0.16 mmol/l in the control group. In dogs of the experimental group 2, on the contrary, there was an increase of 3.73±0.08 mmol/l ($p<0.05$) compared with the 20th day.

According to the results of the study (Figure 2), the amount of alkaline phosphatase (AP) in the blood of dogs of the 1st and 2nd experimental and control groups before surgery averaged 97.57±15.69 mmol/l, respectively; 109.46±22.97 mmol/l and 90.40±5.38 mmol/l ($p<0.05$).

By the 10th day of the experiment in the blood of dogs of all three groups, an increase in AP relative to the initial level was detected (129.25±19.73; 129.63±20.42; 110.83±6.28 mmol/l p<0 .05 respectively). By the 20th day of the experiment, the level AP in the blood of dogs of the first experimental group was 125.35±14.25 mmol/l ($p<0.05$), and in the second experimental group it was 102.17±17.59 mmol/l ($p<0.05$), and in the control group this number was higher than on the 10th day (112.27±7.98 mmol/l $p<0.05$).

On the 30th day of the experiment, blood serum AP in dogs of the first experimental group was 104.35±5.44 mmol/l ($p<0.05$), and in dogs of the second experimental group - 86.50±4.38 mmol /l ($p<0.05$) and 86.57±9.57 mmol/l ($p<0.05$) in dogs of the control group.

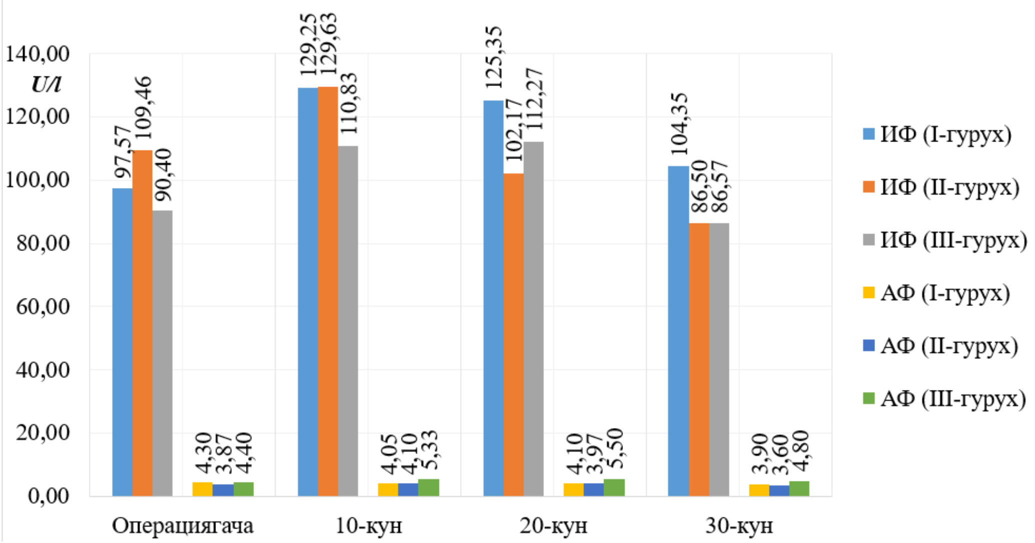

Figure 2. **Dynamics of AP and BP**

According to the results of the experiments (Figure 2), the average amount of bitter phosphatase (BP) in the blood of dogs in the experimental groups of the 1st, 2nd and control groups before surgery, respectively, in group 1 was 4.30±0.08 mmol/l; 3.87±0.29 mmol/l in the 2nd group; 4.40±0.21 mmol/l ($p<0.05$), and a decrease in BP was observed in dogs of the 1st experimental group on the 10th day after surgery (respectively 4.05±0.52 mmol/l p< 0.05). In the experimental group 2 and the control group, an increase was revealed relative to the initial state (4.10±0.17 mmol/l; 5.33±0.26 mmol/l $p<0.05$, respectively). On the 20th day of treatment, the amount of bitter phosphatase in dogs of the 1st experimental group was 4.10±0.24 mmol/l, in the 2nd experimental group - 3.97±0.24 mmol/l, and in the control group it was the highest during the experiment (5.50±0.35 mmol/l $p<0.05$).

During the experiment, it was found that the amount of BP was higher in the control group than in the dogs of the experimental group, which indicates that the processes of bone healing in the dogs of the control group proceeded much more slowly. By the 30th day of the experiment, the BP level decreased in dogs of the 1st experimental group (3.90±0.50 mmol/l, $p<0.05$), which was also observed in dogs of the 2nd experimental group (3.60± 0.18 mmol/l, $p<0.05$), BP in control dogs was higher than before and decreased from day 20 (4.80±0.29 mmol/l $p<0.05$).

Conclusions

1. In all three groups of dogs undergoing intramedullary osteosynthesis, the amount of hemoglobin in the blood and the number of erythrocytes decreased and increased after 10 days of the experiment.
2. Hematological parameters of dogs of the 1st experimental group on the 20th day of treatment of bone injuries indicate the completed early anabolic stage of the traumatic process.
3. The fact that the number of leukocytes in the blood of the dogs of the control group on the 10th and 20th days of the experiment was higher than in the dogs of the experimental group indicates a high inflammatory process and may indicate a weak level of hematopoiesis in the animals of this group.
4. ESR in the blood of dogs of the first experimental group at the end of the experiment was within the normal range. ESR in the blood of dogs of the second experimental and control groups during and at the end of the experiment was higher than the initial state. Inflammation after surgery and trauma is a clear sign of the development of events, and serves as an ESR level. In both groups, its level increased sharply.
5. With fractures of tubular bones, it is important to determine the amount of total calcium and inorganic phosphorus in the blood, which allows you to control the process of osteogenesis at the fracture site. The process of osteogenesis in fractures is manifested by an increase in the amount of total calcium and inorganic phosphorus in the blood.
6. The amount of calcium and inorganic phosphorus in the blood of dogs of the 1st experimental group was higher on the 10th and 20th day of the experiment than in dogs of the other group.
7. Determination of the level of alkaline and bitter phosphatases in fractures of the tubular bones of animals can be considered a test marker of biochemical changes in the bone.
8. The amount of AP in the blood of the dogs of the experimental group was higher than in the animals of the control group.
9. An increase in alkaline phosphatase is a sign of accelerated healing and compaction in a broken bone.
10. The amount of BP was higher in the animals of the control group than in the dogs of the experimental group. High levels of BP indicate that the healing process in dogs' bones is much slower.

References:

1. Vasilyeva E.A. Clinical biochemistry of farm animals. - Moscow, 1982. - p 85
2. Desyatnichenko K. S., Kuftyrev L. M., Pozharishchensky L. D. and others. Assessment of the state of skeletal homeostasis in patients with cystic bone lesions under conditions of transosseous osteosynthesis. - Kurgan, 2000. - No. 2. p 86-87.
3. Shevtsov V. I., Popkov A. V., Desyatnichenko K. S. et al. // The Genius of Orthopedics. - 1999. - No. 11. p
4. Shepetkin I. N. // Successes of modern biology. - 1996. - T. 116. - Issue. 4. p 444.
5. Derkho M. A., Kontsevaya S. Yu., Prediction of the course of the reparative process in transosseous osteosynthesis. // Veterinary. - 2004. - No. 2. - p 53-56.