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DEVELOPMENT OF A REHABILITATION PROGRAM FOR ANIMALS AFTER OSTEOSYNTHESIS

Abstract ***:*** *The article presents the results of the study - the main goal of the research is to develop a rehabilitation program after osteosynthesis, taking into account the anatomical, topographic and physiological characteristics of dogs, using modern methods and means. The developed program will serve as the subject of the study* [1].

After stabilization of bone fragments and osteosynthesis, the animals were divided into two equal groups. All animals of the first group received drug therapy, animals of the second group underwent rehabilitation according to the developed program. Clinical and radiological methods were used for the study.

The effectiveness of this rehabilitation development was used in the veterinary clinic TsVM Doctor Vet.

Key words: dog, bone osteosynthesis, veterinary rehabilitation, developed program, physiotherapy, manual therapy, antibiotic therapy, massage, cryotherapy, transcutaneous electrical neurostimulator, joint gymnastics, exercises, hydrotherapy, pain syndrome, support ability, proprioception, edema, mental status.

Key words: *osteosynthesis, rehabilitation, developed program, physiotherapy, manual therapy, antibiotic therapy, hydrotherapy, weight-bearing ability, edema, mental status.*

Introduction

Research in the field of traumatology is a pressing issue today. This research work is the development of rehabilitation for animals after osteosynthesis of limb bones.

Bone fractures are one of the most common problems among small pets, regardless of species, breed, age, and account for 45% of all non-infectious diseases. [2,3].

Bone fractures are always given considerable attention, since with limb fractures, the supporting and motor function is impaired and complications often occur. Timely osteosynthesis of limb fractures and the correct approach to treatment are of great importance in recovery .

The main goal of osteosynthesis is to restore the function of limb movement; rehabilitation methods have been developed that do not restrict limb movement. Extra-bone osteosynthesis has proven itself in the treatment of bone fractures [4] .

One of the only criteria for the effectiveness of the treatment was the preservation of life and the injured area of the patient; as this area of veterinary medicine actively developed, an indicator such as “quality of life after injury” emerged, which forced the development of a rehabilitation method [5] .

Research methods

The work is based on the results of our own research at the TsVM "Doctor Vet" clinic.

The subject of the study is the development of a rehabilitation program after osteosynthesis in small domestic animals.

The object of the study was 5 dogs that had undergone osteosynthesis of the femur. Dogs of different breeds, weight category 10-25 kilograms, in the age range from 4 months to 5 years were selected for the study. The experiment was conducted according to the scheme.

After the operation, the animals were divided into 2 groups, 5 animals in each group.

Titanium plates were used to stabilize bone fragments. This method of osteosynthesis is preferable, as it provides reliable fixation and the ability to carry out rehabilitation measures.

After the operation, the animal was assigned to one of the groups. In the first group, the animals underwent standard postoperative drug therapy (Table 1). The animals of the second group received the same drugs, but together with rehabilitation according to the developed program.

Clinical research method

The clinical examination included collecting anamnestic data, measuring general clinical indicators, and assessing the emotional state in order to identify pain syndrome.
When collecting the anamnesis of life, attention was paid to the conditions of keeping, exercise and diet of dogs, taking into account the age and breed characteristics of the animals.
The medical history is compiled taking into account the etiology of the injury and the course of the operation.

Method of bone osteosynthesis in the treatment of femur fractures in dogs.

The use of metal plates has become an important milestone in the development of osteosynthesis practice, as it allows for rigid fastening of fragments, completely eliminating rotation of fragments.

Advantages of this method:

1. When used correctly, it provides reliable stabilization of bone fragments;
2. Unlike percutaneous fixation devices, it does not create a gateway for infection, since the surgical wound completely heals;
3. Does not interfere with the dynamic functions of the limb, since it does not extend beyond the diaphysis of the bone, which allows the animal to more quickly use the limb in support (which is very important);
4. Situations where a repeat operation to remove the plate are required are rare;
5. Extramedullary osteosynthesis allows for stabilization of fragments for a (long) unlimited period of time, without interfering with the limb's movement. This is especially important when fracture healing is slow. In such cases, transcutaneous osteosynthesis is not applicable at all, since the presence of an infection gate for more than 2 months may pose a threat of infection penetration into the bone from the outside. And intramedullary osteosynthesis with pins and spokes may limit the motor functions of adjacent joints.
6. Unlike intramedullary osteosynthesis, extramedullary osteosynthesis does not injure (or injures less) the bone marrow, which has a positive effect on the restoration of bone trophism, and therefore on fracture healing [5].

Despite its significant advantages, this method also has disadvantages:

1. A wider surgical field is required than with intramedullary osteosynthesis, which means that the nutrition of the periosteum will be more disrupted;
2. The periosteal area under the plate will become almost completely necrotic and the healing of the fracture under the implant will be slowed down, but only under it.
3. Sometimes it is necessary to remove the plate and screws, as there may be rejection reactions (foreign object), which requires a repeat operation.

But there are usually no serious problems when using materials made of titanium alloys. The choice of one or another method of osteosynthesis depends on the characteristics of each case.

4. Impaired sensitivity.
5. Joint contracture
6. Osteomyelitis.

Technique of the operation. After the anamnesis has been clarified, a mandatory clinical examination and X-ray examination of the injured segment is carried out in order to determine an accurate diagnosis (Figure 7).

Fig. 1 Comminuted fracture in the metaphysis of the femur caused by an air gun shot

The animal is prepared for surgical intervention. If there are no contraindications to osteosynthesis, the owner's written consent for surgical treatment of the pet is taken. After that, depending on the type, size of the animal, as well as the location of the fracture and the nature of the fracture, plates and screws of the appropriate length and size are selected, and the instruments necessary for osteosynthesis are prepared.

Animals are put under anesthesia, using drugs such as Propofol Kabi, Zoletil, intravenous administration. After immersion, the surgical field is prepared.

When accessing bone fragments, the incision is made along the muscle fibers, since this type of osteosynthesis is accompanied by trauma to soft tissues, this fact is not unimportant.

Under the influence of muscle contraction, bone fragments often move relative to each other. Reposition of bone fragments is performed using hooks if the animal is large, but most often manually. After reposition, a plate is applied to the bone and inserted (Figure 9).

Fig. 2 Installing the plate

The plates have holes in them, the number of which varies depending on the size. In all animals, the plates are applied in such a way that there are at least two holes on each side of the bone fragments and the screws are at a sufficient distance from the fracture zone when installed.

After inserting the plate, it is pressed against the bone using bone holders. This prevents the bone fragments from shifting and separating. Using a screwdriver, holes are drilled into the bone; the drill diameter should be smaller than the screw diameter; if the screw diameter is 3 mm, a corresponding drill with a diameter of 2 mm is used. Screw threads are cut in the drilled holes using a tap to facilitate the installation of screws and prevent bone splitting. The plate is tightened to the bone with screws, the bone holders are removed, while making sure that the fragments are firmly fixed and tightly adjacent to each other. If the plate is inserted incorrectly, it may break under the load on the limb.

Once you have made sure that the plate is correctly applied, you can begin closing the surgical wound. The plate is closed with muscles and sutured. In most cases, subsequent removal of the plate is not required.

Fig. 3. Postoperative suture

Extra-osseous osteosynthesis of the femur, if the necessary instruments and consumables are available, is not very difficult to perform.

An X-ray examination was performed to confirm the preliminary diagnosis.

Dynamics of hematological changes during therapy in dogs of experimental groups.

The first thing we ordered before the surgery itself was a complete blood count. A complete blood count (CBC) can help determine the general condition of the dog and the presence of abnormalities in the functioning of the systems. The norms for a complete blood count are presented in Table 3.

Table 1

Clinical parameters are normal

Indicator	Norm for adult dogs
Hematocrit (%)	37-55
Hemoglobin (Hb)(g/l)	115-185
Erythrocytes (million/mcl)	5.3-8.6
Color indicator	0.73-1.06
ESR (mm/h)	2-8
Leukocytes (thousand/μl)	6-17
Eosinophils (% or U/μl)	100-1200
Basophils (% or U/μl)	Up to 55
Lymphocytes (% or units/μl)	1100-4800
Continuation of table 1	
Monocytes (% or U/μl)	160-1400
Platelets (thousands/μl)	250-550

The hematological examination consisted of a general blood test and determination of the following parameters: hematocrit, hemoglobin, color index, erythrocyte sedimentation rate, number of erythrocytes, leukocytes, eosinophils, basophils, monocytes, platelets.

The first study was conducted before the operation. The results of the analysis of dogs of the first group are in Table No. 2.

Table 2

Results of a general blood test in dogs of the first experimental group

No.	Indicator	Dog #1	Dog #2	Dog #3	Dog №4	Dog №5	Average for the group
	Hematocrit (%)	35	36	30	32	28	*32.2*
1.	*Hemoglobin (g/l)*	90	95	92	103	90	*94*
2.	*Erythrocytes (million/mcl)*	4.2	4.5	4.0	5.0	4.2	*4.38*
3.	*ESR (mm/h)*	17	14	20	12	25	*17.6*
4.	*Leukocytes (thousand/μl)*	25	26	30	22	38	*28.2*
5.	*Eosinophils (U/μl)*	150	125	146	130	155	*141.2*
6.	*Basophils (U/μl)*	55	57	60	47	65	*56.8*
7.	*Lymphocytes (U/μl)*	3790	3180	4020	3745	4170	*3781*
8.	*Monocytes (U/μl)*	757	700	917	605	835	*762.8*
9.	*Platelets (U/μl)*	245	250	235	260	130	*224*

A complete blood count showed a blood picture typical for a bone fracture. As a result of blood loss, the development of inflammation and pain syndrome, a decrease in the number of red blood cells was revealed, and as a consequence, a decrease in the percentage of hematocrit and hemoglobin levels, a significant increase in the erythrocyte sedimentation rate and the number of leukocytes. Average indicators for the group: hematocrit - 32.2; hemoglobin - 94; erythrocytes - 4.38; ESR - 17.6

The rehabilitation program for animals of the second group uses the transcutaneous electronic neurostimulator "Digital Meridian - HealthHerald ".

HealthHerald Features: Treatment is performed using electrical micro-impulses.

Table 3 - Postoperative therapy scheme for dogs of experimental groups

No.	Medicine	Scheme of reception	Note
1.	Melbek, non-steroidal anti-inflammatory	Intramuscularly 1.5 ml, every 12 hours for 3 days. If necessary, the course is extended to 5-7 days.	Analgesic, anti-inflammatory, antipyretic effects
2.	Ceftriaxone, a broad-spectrum antibiotic, has the property of accumulating in bone tissue	Intramuscularly, 4 ml once a day for 10 days	Prevention of infectious complications
3.	Vitam, vitamin-mineral complex	Subcutaneously, 5 ml once a day for 5 days	Increasing the body's resistance, eliminating the side effects of antibiotics
4.	Chlorhexidine, antiseptic	Treatment of postoperative suture. Twice a day until complete healing.	Prevention of microorganism development in the area of the surgical suture

Research results

As a result of control examinations in the first group, the following conclusions can be made.

1. Normalization of appetite occurred by day 10, and improvement of emotional state on day 10-15 after osteosynthesis. All dogs had severe pain syndrome on day 3, judging by mental status and increased pulse rate and respiratory movements. The introduction of NSAIDs was continued for another 2 days.

2. The swelling subsided 10-15 days after the operation.

3. The dynamics of the return of the supporting ability of the operated limb is low. By the 30th day after the operation, not a single animal had full supporting ability.

Another examination was performed on the 60th day after osteosynthesis. The owners noted full support ability on the 40-50th day. However, short-term lameness was noted in 4 dogs during long walks and games. Slight atrophy of the femoral muscles was observed in 3 dogs. All dogs showed a lack of muscle mass [6,7] .

As a result of control examinations in the second group, the following conclusions can be made.

1. Normalization of appetite was observed on the 2nd-3rd day, improvement of emotional state on the 3rd-5th day. Signs of pain syndrome are not expressed. Extension of the NSAID course was not necessary.

2. Swelling in the first days is moderate, swelling subsides on the 3rd-5th day.

3. The dynamics of the return of the ability to support weight is high. Full ability to support weight was noted on the 20th-25th day. Proprioception is preserved.

4. No postoperative complications were observed.

5. The tasks set at each stage of rehabilitation were completed.

Similar to the first group, another control examination was conducted on the 60th day after the operation. The dogs live a full life, the functional capacity of the injured limb is fully restored (Appendix 3, Fig. 27).

A comparative analysis of the clinical examination results showed that the recovery of the second group of dogs was more dynamic. The difference in appetite normalization is 7-8 days, improvement of mental status 10-12 days; edema reduction 10-12 days; full support ability 20-25 days.

Discussion of scientific results

During the study, we had to develop a program for the rehabilitation of animals after osteosynthesis of the femur and evaluate its effectiveness. The developed program had to meet the modern requirements of veterinary traumatology and rehabilitation.

As a result of the work carried out, a program was developed, and rehabilitation measures were carried out at each stage.

Previously, only drug-based pain relief using non-steroidal anti-inflammatory drugs was used in practice [9].

For the first time, a transcutaneous electroneurostimulator was used, which performed several functions using different modes of action, throughout the rehabilitation. The essence of this method is the effect of electrical micropulses on the femoral nerve, for pain relief and preservation of muscle proprioception. To drain postoperative edema, electrodes were installed in the area of the postoperative suture, i.e. regionally. At each stage, a certain mode was set, according to the recommendations of the manufacturer of the device used.

With the start of the exercises, the dogs began to lean on the operated limb with noticeable confidence.

As a result of rehabilitation measures under this program, we were able to reduce the time it takes to restore the functional capacity of the hind limb and the entire body as a whole, and also avoid postoperative complications [10] .

Conclusion

Restoration of the integrity of the femur bones was carried out by the method of bone osteosynthesis. This method allowed to carry out the necessary rehabilitation measures, thanks to the closed method of osteosynthesis.

The analysis of the clinical examination results during control examinations revealed that in the dogs of the second group the restoration of the functional ability of the hind limb occurred earlier than in the dogs of the first group. The restoration of proprioception and full support ability was more dynamic in the second group with a difference of 20-25 days. No postoperative complications were observed.

With a single drug therapy, the results of the second experimental group were significantly better, which proves the effectiveness of the developed rehabilitation program. The rehabilitation measures taken allowed to reduce the time of restoration of the functional capacity of the injured hind limb and the whole organism as a whole, without concomitant postoperative complications [11] .

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