HETEROLOGOUS CARBONATED NANOCRYSTAL BONE MINERAL IN THE TREATMENT OF THE UNUNION FEMUR IN DOG

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Abstract

This report describes the treatment of osetomyelitis of the femur of 9-month-old dog with the use of heterologous carbonated nanocrystal bone mineral and collagen, stabilised by a bone plate. In this dog, due to mistakes during earlier stabilisation, bone infection and sequestration had arisen. After antibiotic therapy, plating stabilisation was carried out. Osteosynthesis with the use of dynamic compression plate and heterologous carbonated nanocrystal bone mineral and collagen was an effective method of stabilisation, which led to the bone healing. Clinical significance: Heterologous carbonated nanocrystal bone mineral and collagen in preparation OsteoBiol turned out to be an effective material in the treatment of the lack of bone. The clinical case outlined is the first notification, which describes the applying of the preparation in therapy of osetomyelitis of the femur in a dog.

Key words: dog, heterologous graft, bone fracture, osteosynthesis.

Bone healing is a complicated process of cell interactions, and their aim is callus formation. The healing of damaged and stabilised bone takes place during biologically-ordered, sequential phases. Disturbance of the bone-healing process could extend to delayed union or nonunion of the bone. There are many causes of disruption of bone healing. It is considered that the co-existence of infection and the lack of stability along the line of the break create the worst conditions to cure bone infection and obtain bone union. During bone infection, the bacterial metabolites increase vessel damage, regardless of immediate toxic impact on bone tissue. Böhm (2) has observed chronic bone inflammation, independently from the creation of bone necrosis; the symptoms of secondary artery inflammation and internal thromboses. Therefore the problem of restoring and holding the stabilisation of the bone’s fragments during osetomyelitis treatment becomes the central issue during complicated medical treatment of bone adhesion in dogs.

The idea of the research was to demonstrate the results of treatment of osetomyelitis of the femur with the use of heterologous carbonated nanocrystal bone mineral and collagen.

Description of the case

In October 2007, a 9-month-old, weighing 32 kg, cross-breed bitch was referred to the clinic with a history of 5-d-earlier intramedullary fixation with a single Steinmann pin and three cerclages of a comminuted left femur fracture. On presentation, the dog was unable to walk on its rear left leg. Clinical examination revealed a rectal temperature of 40.1°C, higher temperature of the left femur than the right one; oedema of this leg; much magnification of the left stifle lymph node; and the Steinmann pin protruded 3 cm above the skin. The last observation was confirmed during radiological examination (Fig. 1). Apart from this, the dog did not demonstrate other health disorders and had normal appetite and thirst.

The owner of the dog was informed about the suspected septic femur bone infection. Despite this information the dog’s owner demanded immediate surgery.

Thirty minutes before surgery, the dog received the antibiotic Cephalexim 10 mg/kg i.m. (Cefalexim, Scanvet, PL). After the premedication with 0.05 mg/kg i.m. of acepromazin (Sedalin, Vetoquinol, France) and 1 mg/kg i.m. of xylazine (Vetaxyl, Vetagro, Poland), the induction of general anaesthesia was carried out by the use of 3 mg/kg i.v. of ketamine hydrochloride (10% Ketamina, Biowet, Poland) and 0.3 mg/kg i.v. of diazepam. (Relanium, WZF Polfa, Poland), and then the anaesthesia was maintained with halotan (Narkoton, Leciva, Czech Republic).
Fig. 1. Radiographic picture of protruded pin.

Fig. 2. Bone osteolysis in contact site with nails.

Fig. 3. Radiographic view after two trials of fracture stabilisation.

Fig. 4. Ten weeks after final successful DCP stabilisation with heterologous bone material.
After protruding pin removal, the craniolater approach to the shaft of the femur was done. Two free bone pieces with necrotic changes and without blood supply and two cerclages were removed. The region of the fracture and soft tissues was rinsed with 1,000 ml of 0.9% NaCl solution. Next, the fractured femur was stabilised using an external fixator with Ellis. The bone defects were filled with autogenous cancellous bone grafts taken from proximal humerus. The soft tissues and skin were sutured. The dog received Cephalexin for 7 d after the operation.

After 29 d, the owner returned to the clinic. During the anamnesis and clinical examination, lack of appetite for 2 d, oedema in the region of the left thigh, serous-pus discharges in all places on skin in the area of the Ellis nails, and two fistulas in the region of the left under-knee region, were ascertained. The left under-knee lymph node increased to about 3 cm and the temperature of the body was 40.2°C. In a radiological examination, osteolysis was found in the region of the Ellis nail thread (Fig. 2).

The external stabiliser of the nails was removed and swabs from the wounds were taken for bacteriological tests. Before bacteriological examination, 10 mg/kg p.o. of clindamycin (Dalacin C; Pfizer) was given. After 7 d, the tests on the swabs demonstrated the presence of *Staphylococcus aureus* and *E.coli*. These strains are resistant to the majority of antibiotics, except for amoxicillin with clavulanic acid, erythromycin, bacitracin, cephalolin, and gentamycin. For practical and pharmacological consideration amoxicillin was chosen and a dose of 15 mg/kg p.o., (Amoxiclav, Lek, Slovenia) for 6 weeks was recommended. In the fourth week of the treatment, the next bacteriological test showed a single-growing *Staph. aureus*. A decision was made about the next osteosynthesis.

Before surgery, a radiological examination was done and osteomyelitis was found in the middle of the femur shaft, and the presence of single cerclage and single sequestrum (Fig. 3).

Fracture management was made with the use of a DCP plate. After the cerclage and sequestrum were removed, the fracture line was surgically located. The plate was put on and the bone loss was filled with 2 g of heterologous carbonated nanocrystal bone mineral and collagen (Osteo-Biol, Tecnoss, Italy). The soft tissues and skin were sutured and two drains were put on to fistulas for 4 d.

Ten weeks following surgery, clinical and radiological examinations were made. Shortening of the operated-on hind leg, and femur muscular atrophy were found in a clinical examination. The treated hind leg was swollen at the end of the paw. The radiological examination showed the bone healing and callus formation in the treated femur (Fig. 4).

The rehabilitation of the operated-on hind leg was recommended. Based on clinical examination and frequent telephone contact with the dog’s owner, it was found that dog was almost normal; the dog put its leg on the pads and the owner was pleased with the results of the surgery.

**Discussion**

In the described case, the fracture of the femur bone was healed in spite of the long period of treatment due to the incorrect method of osteosynthesis and infection in the environment of broken bone during the first surgery. The second mistake was submitting to and imposing the owner’s will on the surgeon that, regardless of an existing septic condition, the fractured bone should be stabilised once more, whatever the cost. The series of wrong decisions and methods of stabilisation caused the development of fracture instability, an osteomyelitis of the bone, and sequestration. In the presented case two main factors had an influence on bone union; they were firm bone stabilisation with DCP plate, and usage of heterologous carbonated nanocrystal bone mineral and collagen.

The problem of infected bone stabilisation is rousing a lot of emotions and the idea of correctly-performed stabilisation of such bone with the presence of the active process of infection generates huge opposition. Osteosynthesis in the infected environment is much more difficult than working with a fresh fracture (3, 5, 6). In the described case, intramedullary fixation was a fundamental mistake. First of all it caused the spreading of infection on previously an unchangeable bone area and it did not guarantee stabilisation of the bone’s fragments. In order to perform the stabilisation of the infected bone one should remember about contraindications to doing it. The fundamental contraindication is the presence of sequestrums, pyohaemia of the medullar cavity of bone, and increased infection of soft tissues. Furthermore, the infected bone, which is inflamed, has a different strength and it is easier in the case of bone to reach destabilisation of the stabilising system. It should be remembered that the aim of osteosynthesis in the infected environment is also to restore mechanical silence in the fracture site. In osteomyelitic unstable fracture, it was decided to manage the infected bone by DCP, but after antibiotic therapy, which lasted 4 weeks. During the stabilisation of the plate, the area of bone loss was filled with heterologous carbonated nanocrystal bone mineral and collagen *via* reconstruction in order to speed the healing processes of the bone. The basic principle for managing fracture repair is to stimulate bone healing with bone grafts, especially cancellous bone. The goals of bone grafts are stimulating osteogenesis at the fracture site, and mechanical support. In the described case, because of an osteomyelitis, long-term therapy with antibiotics and usage of heterologous carbonated nanocrystal bone mineral and collagen in the fracture site were done.

In medical literature, there are not many reports, which describe results of treatments using heterologous carbonated nanocrystal bone mineral and collagen as the material to fill the loss of bone (1, 4). Using the Osteo-Biol preparation in the treatment of fracture bones has not been described in veterinary literature until now. This is the first report in which the preparation Osteo-Biol was successfully used in the treatment of the loss of a dog’s femur bone.
References


