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# THE EFFECT OF THE CRYOTHERAPY ON THE HEALTH AND WELFARE OF DOGS: PRELIMINARY STUDY

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## ABSTRACT

**This study is focused on determining the cryotherapeutic effects in the treatment and welfare of dogs. We characterized the basic principles of cryotherapy as well as summarized and statistically processed the current state of the application of this form of therapy in a veterinary practice. Recent scientific studies have shown that cryotherapy is mainly effective in treating skin diseases and problems with the musculoskeletal system including minor injuries caused by excessive muscle strain. It can also be used in combination with anti-inflammatory drugs to treat the respiratory system. Moreover, cryotherapy can be an effective form of treatment for ageing. Our study involved a survey evaluation given to veterinarians in Slovakia, Czechia, and Hungary with a key question regarding their experiences with cryotherapy and cryosurgery in dog therapy. Statistical results demonstrated that Slovak veterinarians do not utilize cryo-methods satisfactorily. A summarization of the reasons could start a change in this unfavourable aspect in Slovak veterinary medicine and contribute to better promotion of cryotherapy application in the therapy of animals.**

**Keywords: cryosurgery; cryotherapy; cynology; dogs; questionnaire**

## INTRODUCTION

Cryotherapy (the word cryos is of Greek origin and means frost or cold) has been a therapeutic method used in human and veterinary medicine to treat certain diseases, mainly injuries and inflammations since ancient history. It is documented that the ancient Egyptians had utilized the cold for the injuries treatment, even before 2500 BC. Simple tools like ice or cold compress were substituted with liquid carbon dioxide ($CO_2$) in the early 1920s to treat skin lesions and gynecological problems in humans. The deficiencies of therapy with liquid $CO_2$ led to the application of liquid nitrogen in cryotherapy [13].

The effect of low temperature on the cellular level manifests mostly by necrotisation. Rapid cooling of the tissue to a temperature below –25°C followed by slow thawing results in the damage of the tissue cells by the necrosis process which is influenced by several factors acting synergistically on the cells.

The most important consequence caused by rapid

freezing is the formation of intracellular crystals inducing irreversible lesions and electrolyte concentration changes within the cells. Then the phospholipid cell membranes are broken, and in turn, extracellular crystals are formed. These phenomena lead to cellular dehydration caused by osmosis across the cell membrane. Finally, the concentrations of intracellular and extracellular electrolytes reach toxic levels.

At the same time, mechanical damage to the cell membrane occurs, and changes in the vascular system happen to result in the formation of so-called cryothrombi in the capillaries. We speak about cryothrombosis if the low temperatures cause alteration of vasomotor function and interstitial oedema promotes a slowing of circulation and an increase in vascular permeability. The decrease in temperature destroys blood elements on the endothelium of the vessels and allows thrombus fixation on the vessel walls. Thrombosis occurs several hours after application of cold to tissue, but usually within 48 hours at the most [28].

Characteristic features of cryotherapy include: reliable necrotisation of soft tissues, thrombotisation of capillaries, reversible anaesthesia of the peripheral nerves, larger vessels remaining intact, and blood circulation being fully restored in them after thawing without negative consequences, and the mineral envelope of the bones remains unchanged. The cold reduces blood flow by increasing its viscosity, vasoconstriction, and metabolic activity reducing, which reduces the oedema formation at the site of the injury [19]. Analgesia results from an alteration in the cellular metabolism and slowing of nerve conduction velocity in the motor and local sensory neurons [9, 15, 18, 26]. An additional benefit is that it decreases the concentration of inflammatory mediators, including tumour necrosis factor-α and nitric oxide [31].

Cryotherapy uses freezing temperatures to destroy cells in target tissues. Most cells are made up of about 70 % water. Inside the cells, ice crystals begin to form after exposure to freezing temperatures, which tear them apart. Subsequently, further damage to cells and tissues occurs when the blood vessels supplying the diseased tissue freeze. Cryosurgery (a special part of cryotherapy) is usually performed using liquid nitrogen. Supercooled liquid nitrogen (–196 °C) is sprayed onto the affected tissue with a cryoprobe or by using a swab. More modern applications include ultrathin needles that are capable of using argon to form ice. This procedure provides good control over the amount of frozen tissue and helps to minimize complications [14, 29, 30]. Cryotherapy in conscious dogs appears to be well-tolerated [2].

The treatment progress can be schematically divided into several stages. After the actual freezing and subsequent thawing, necrosis formation and debridement occur. The necrosis of the cryopreserved tissue usually takes 48 hours. Then, the necrotic masses begin to separate and are eliminated from the organism. The stage of necrosis debridement usually lasts about one week, then it is replaced by the stage of granulation when the lesion formed by cryallisation is filled with granulation tissue. The granulation stage can last up to three weeks, possibly longer depending on the size of the defect. The whole procedure concludes with the epithelization process, which is a smooth continuation of the previous stage. The treatment can be accelerated, especially at the necrosis removal stage, with the help of enzyme therapy. The granulation can be promoted by massaging the healing tissue, e. g. under a stream of running lukewarm water. For this reason, animals are not prevented from licking the healing defect at this stage [28].

The advantages of cryotherapy include the possibility of using it even in critical areas where the application of a conventional procedure would pose too high a risk if the immune system responds favourably to the therapy. This method is almost painless, it can be used without general anaesthesia, only in local anaesthesia of frozen tissue, or with the use of tranquilization of the patient. It presents minimal risks of postoperative bleeding and complications [2, 5, 7]. If necessary, the procedure can be repeated or the cryotherapy can be combined with other treatment methods. After cicatrisation, a very good cosmetic effect is achieved without adverse side effects [2, 7].

The positive effects of cryotherapy in the treatment of individual health problems in dogs are: reduced stress and anxiety [10], improved coat quality [27], elimination of skin disorders (atopic dermatitis, parasites, folliculitis, pustular dermatitis, dermatophytosis, yeast infections, and seborrhoea), improved mobility in patients with chronic inflammation of the joints and neurological diseases. For joint inflammation and pain, it shortens the healing phase and also relieves pain in hip and elbow dysplasia [21].

This type of therapy is also used in the treatment of other diseases such as: tumours, glaucoma, oral surgery, epulis, cysts, itchy lesions, distichiasis (removal of aberrant or extra eyelashes), warts, eczema, and other skin

disorders, such as: joint inflammation, musculoskeletal problems, gynecological diseases, and cryoextraction of the lens in cataract surgery [3, 6, 11, 16, 23].

We consider all contraindications to cryotherapy to be relative. Cryosurgery is believed to have more effective and a safer use in benign or less active malignant tumours. Melanomas are considered unsuitable for cryosurgery, but recent research in this field has been very intensive [28].

Cryotherapy like the other therapeutic methods based on physical phenomena has been predominantly used in human medicine. Step by step it expands into veterinary practice including dog therapy as can be seen from the above-mentioned applications. Our study was aimed at bringing some information about therapeutic advantages linked to the use of low temperatures in veterinary medicine. The main goal of this paper was a preliminary exploration of a fact how frequently cryotherapeutic methods are utilized by veterinarians in our close area.

**Application of cryotherapy in practice**

The simplest method of cryotherapy in practice is the use of an ice pack or bandage. Cryobandages enable the patient to begin using the limb earlier after surgery, reduce recovery time, and improve tolerance to other rehabilitative techniques [4]. The recommended length of time for ice pack application per session is 10–20 minutes to reach deeper tissues (to a depth of 1.5 cm) and provide longer-lasting effects [1]. The ideal frequency of administration of cryotherapy in dogs is unknown, but protocols using cryotherapy once daily up to every 4–6 hours have been advocated. Compared to control dogs following surgery, using an ice pack secured around the stifle with an elastic bandage for 20 minutes provided continuous cooling and allowed passive range of motion exercises to be tolerated [22]. Cryotherapy can also be administered using a compression system that circulates ice water in a bladder wrapped around the limb which massages the limb at the same time as reducing tissue temperature [17]. This system improved weight-bearing when used every 4–6 hours in the first 24–72 hours following surgery, and improved range of motion, reduced pain scores, and reduced lameness for up to 42 days postoperatively compared to dogs not receiving the therapy [12, 15].

Technical equipment working with liquid nitrogen, so-called cryocautery machines, are commonly available, also in the Czechia. The new generation devices are controlled by microprocessors, they are autonomous, i. e. not connected to the nitrogen bomb, which makes it possible to control the cooling rate. Cryoprobes, by which wave freezing is carried out, have interchangeable endings depending on the shape and nature of the lesion being treated. For flat lesions and smaller tumours, passive tips are suitable, which are only applied by the doctor to the part of the patient's body that is being treated with freezing. They are usually made of aluminum. To ensure a better contact with the tissue, it is recommended to coat the passive tips with an intact gel before cryallisation. When treating larger tumours, it is necessary to use active tips, which are equipped with tiny channels leading the liquid nitrogen to the frozen area to be treated. The freezing surface of these tips can also be tipped with spikes that penetrate directly into the tumour, thus achieving significantly lower temperatures not only on the surface but also inside the tumour. The active tips are made of copper and their surface is gold-plated [28].

The most commonly used cryotherapy devices include cryospray and cryocautery machines. Cryospray is an effective way to remove pathological skin processes as gently as possible and without the need for surgery. Warts, skin tumours, and ectopic eyelashes on the eyelids are eliminated precisely with liquid nitrogen. The temperature of –196 °C causes the destruction of pathological tissue under local anaesthesia [3]. A cryocautery is a device designed for cryosurgery. It provides fast and efficient cooling of tissue to a temperature of –89 °C. A wide range of interchangeable instruments and spray nozzles are used for the operations, designed by the needs of the different medical fields where cryocautery is used (gynecology, urology, laryngology, ophthalmology, proctology, and phlebology). The nozzles allow cooling of very small areas of affected tissue (several mm) but also large pathogenic areas (a few cm) [25].

## MATERIAL AND METHODS

A survey was selected as a method for our research. We have chosen two forms of the questionnaire to monitor the current state of using cryotherapy on dogs in veterinary practice. The first form was addressed to the dog owners in Slovakia and it was published on the internet. The second one was assigned to veterinarians, it was sent via

e-mail, and the doctors were contacted by phone. We also monitored the application of cryotherapy abroad, namely in the Czech Republic and Hungary, by sending the questionnaires to veterinarians. The questionnaire dedicated to Czech and Hungarian owners has been published on the internet.

**Questionnaire for dog owners**

The questionnaire for dog owners consisted of nine questions. It contained seven structured questions (the owner had the choice of several answers), one open question (the respondent was allowed to answer individually), and one semi-closed question (the possibility to choose an answer or answer individually). General information such as their age or sex was considered in the questionnaire. The questionnaire was preferentially focused on the owners' experiences with cryotherapy.

**Questionnaire for veterinarians**

The questionnaire addressed to the veterinarians consisted of nine questions, containing seven structured, one open, and one semi-closed question. Most of the questions that were proposed have led to the collection of information about veterinarians' knowledge, use, and experiences with cryotherapy applications on dogs' patients. Only two initial questions were devoted to general information about the respondents (age, and gender).

## RESULTS

**Evaluation of the questionnaire done by dog owners**

The study involved 87 dog owners, 42 Slovaks, 25 Czechs, and 20 Hungarians. The average age of the respondents was 21–30 years, 73 were women and 14 were men. The majority of dog owners had completed secondary school.

At the beginning of the questionnaire, we were interested in whether dog owners know what cryotherapy means. 41% of respondents answered positively and up to 59% did not know about cryotherapy. However, of the owners who responded positively, only 9% had visited a veterinarian's ambulance for cryotherapy. A comparison of the results obtained from the different countries shows that the dog owners in Hungary have the most experience with cryotherapy. On the question of which disease the owners visited the cryocentre and what was the progression of treatment, they answered as follows. Approximately 30% of respondents stated treatment of tumours, 20% removal of cysts, and 10% respondents each for diabetes, itchy lesions, elimination of warts, and extraction of the lens during cataract surgery. Ten percent of the dog owners listed that they had not yet visited the cryocentre (Fig. 1).

We further investigated the owners' level of knowledge about the effects of cryotherapy in the treatment of skin defects and musculoskeletal disorders. Surprisingly, up to 68% of respondents did not have this knowledge, and only 32% answered positively (Fig. 2).

One of the questions in our questionnaire focused on the awareness of dog owners about the benefits of cryotherapy. The majority of responses (93%) were negative. Participating dog owners were unaware of the benefits of cryotherapy. Only 7% of the respondents were aware of the positives of the therapy we studied (Fig. 3).

The next question followed the previous one. In this open question, respondents could indicate their own opinion, and the benefits they detected after receiving cryotherapy for their dogs. The most frequent answers included: restoration and relaxation of muscles, an increase of energy and positive mood, reduction of inflammation, relief of pain in muscles, and joints, alleviation of arthritis symptoms, as well as the elimination of skin eczema. As an advantage of cryotherapy, the owners also mentioned the method of treatment, since the patient was treated standing in the cryo-box, its head was out of reach of liquid nitrogen, thus there was no risk of inhaling it, which is very dangerous.

**Evaluation of the questionnaire by veterinarians**

Fifteen veterinarians from Slovakia, ten from Czechia, and also ten from Hungary responded to the questionnaire intended for them. A total of only 35 veterinarians participated in the anonymous questionnaire survey. To obtain more relevant results, we sent the questionnaire to the Chamber of Veterinarians in Slovakia and the Czech Chamber of Veterinarians. To follow the trend in other countries of the European Union, we distributed the questionnaire to the European Board of Veterinary Specialisation. Unfortunately, concerning the validity of the General Data Protection Regulation, the organizations in question were not able to contact their members on such matters. For comparison, we present the results of a questionnaire de-

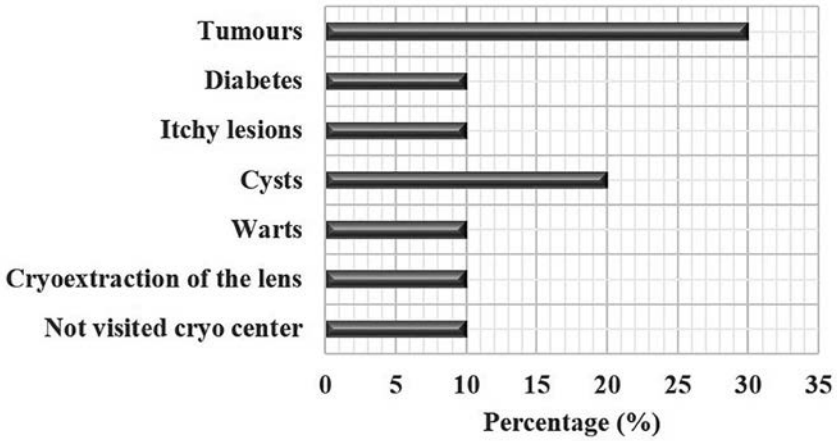



**Fig. 1. Types of diseases that dog owners visited the cryocentre with**

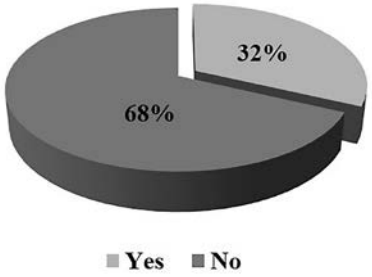



**Fig. 2. The owners' level of knowledge about the effects of cryotherapy in the treatment of skin defects and musculoskeletal disorders**

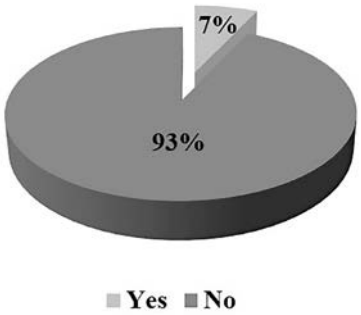



**Fig. 3. The awareness of dog owners about the benefits of cryotherapy**

signed by a veterinarian together with Slovakia, Czechia, and Hungary. For a better explanation, we discuss selected issues separately on a country-by-country basis. The average age of the respondents was 31–40 years, of which 18 were women and 17 were men.

In the first question, we were interested in whether veterinarians have enough information about the possibilities of applying cryotherapy in the treatment of dogs. Almost a third (29%) of veterinarians surveyed are familiar with cryotherapy. However, 71% of practitioners have insufficient information about the use of this therapy in their practice. In the Czech Republic (20%) and Hungary (11%), the situation is worse compared to Slovakia. In Slovakia, up to 47% of respondents answered that they had enough information about the possibilities of applying cryotherapy to their patients (Fig. 4).

When we asked how many veterinarians use this method in their practice, only 29% responded positively. The rest (71%) do not use this therapy at all. The results allow us to conclude that the therapeutic method studied by us is comparably used in practice in Slovakia (33%), the Czech Republic (30%), and Hungary (22%) (Fig. 5).

The following question was asked to find out the number of veterinarians who have experience with cryosurgery. Cryosurgery is a special field of cryotherapy that is used in their practice by 40% of respondents, and 60% of veterinarians have no experience with this therapeutic method. However, it is clear from our survey that cryosurgery is most often practiced by Czech doctors, compared to Slovak and Hungarian ones (Fig. 6).

The next question followed the previous one. With this open-ended question, we monitored, what experience veterinarians have with cryosurgery. The most frequent answers were the positives of the therapy, such as faster recovery after injury, painlessness, and shorter convalescence. As the main advantage, doctors mentioned the unnecessity of general anesthesia during treating patients.

From the results of the questionnaire survey, we can conclude that veterinarians use cryotherapy most often in the treatment of cysts (55%), warts (42%), eczema, and

other skin disorders (21 %) and inflammation of joints (21 %). Diseases such as tumours, epulis, and musculoskeletal disorders each account for a consistent 11 % of total applications (Fig. 7).

12.5 % of respondents do not use this form of therapy in their practice. Slovak and Czech veterinarians do not use cryotherapy in the treatment of cancer. This trend is clearly visible in Hungary, where up to 25 % of respondents routinely apply cryotherapy for tumour removal. In contrast, in Slovakia and the Czech Republic, this method is used for inflammation control, while in Hungary it is not.

The last question of our questionnaire was devoted to the age of patients who received cryotherapy. Up to 84 % of the patients were elderly; younger individuals accounted for only 16 % of the total (Fig. 8).

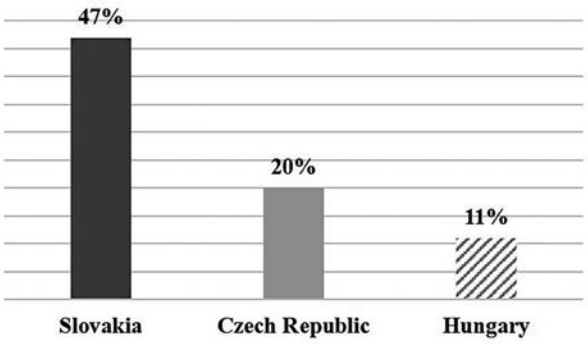



Fig. 4. Awareness trends in Slovakia and neighbouring countries

## DISCUSSION

Cryotherapy is one of the new therapeutic methods. Together with laser and ultrasound therapy, it should be an integral part of every modern veterinary practice. This

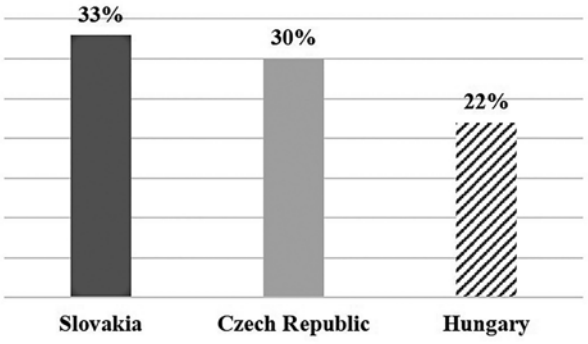



Fig. 5. Usability of cryotherapy in veterinary clinics in Slovakia and abroad

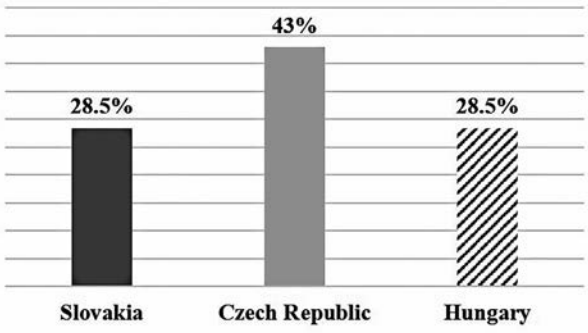



Fig. 6. Cryosurgery in Slovakia and abroad

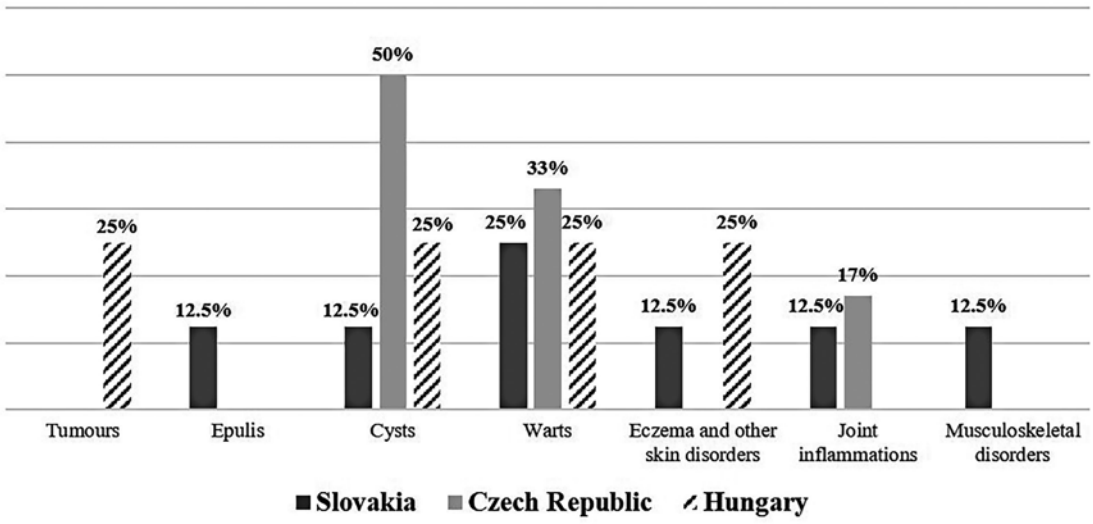



Fig. 7. Diseases treated by cryotherapy

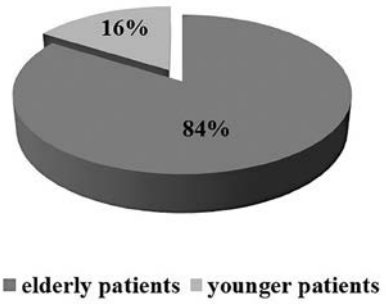



**Fig. 8. Use of cryotherapy to the age of the patient**

work aimed to determine whether veterinarians and dog owners have sufficient knowledge and experience with this therapy. The results obtained from the questionnaires prepared for veterinarians and dog owners allow us to state that almost half of the doctors have knowledge about cryotherapy, but only one-third of them use this therapeutic method in their practice. Cryotherapy is mainly used by doctors in elderly patients for the treatment of arthritis, epulis, eczema, itchy lesions, and other skin defects, removal of warts, cysts, musculoskeletal problems, and lens extraction during cataract surgery. In Slovakia and the Czech Republic, the method we have studied is not used in the treatment of tumours, unlike in Hungary, where up to 25 % of cryotherapy applications are for tumours.

Surprisingly, Slovak doctors have more information about the principles and benefits of cryotherapy than their Czech and Hungarian colleagues, but the number of doctors who use this technique in their practices is almost the same in each country. This may be due to the concern of Slovak veterinarians about the high initial financial costs. However, these fears are unfounded, as the profitability of the initial costs is good considering the price of cryo-therapeutic treatment of dogs. We estimate the return on initial financial costs within 2 to 3 years.

The technique we have studied can also be used in surgery. Cryosurgery is used by only one-third of doctors in their practice in Slovakia as well as in Hungary. In the Czech Republic, cryosurgery is practiced by almost 40 % of veterinarians. We assume that this is a consequence of the fact that the first cryosurgical autonomous nitrogen system for tumour treatment (KCH-3) was developed in the Czech Republic in the years 1977–1983. Czech producers are still innovating their cryocautery machines used in surgery. Promotion, interpretation of the advantages of using these cryocautery devices among veterinarians, and, last but not least, the producers have adapted the price of cryosurgical devices to the financial possibilities of veterinarians in the Czech Republic. If we compare the use of cryosurgery in our geographic area (Slovakia, Czechia, Hungary) with worldwide cryosurgery exploration, it is clear that this method is known and applied more frequently in other countries [8, 20, 24]. Thirty dog patients underwent only one cryosurgery procedure – the removal of eyelid masses under local anaesthesia. Compared with surgical removal and blepharoplasty, the procedure by cryocauter was time- and cost-effective with the additional benefit of not requiring general anaesthesia [20]. Even 200 dogs participated in the cryosurgery treatment of eyelid masses differentiated by benign and malignant tumours in the study by American researchers [24]. The mean recurrence time after cryosurgery was 7.4 months, whereas it was 28.3 months after surgical excision. Moreover, the overall cosmetic appearance was observed to be better with cryosurgery [24].

Another clinical study of cryosurgery efficacy deals with the treatment of skin and subcutaneous tumours in dogs and cats [8]. Cryosurgical tumour ablation was performed by liquid nitrogen cryosurgical spray and the authors declare effective results, especially, in older animals [8].

Dog owners have very little information and knowledge about the therapeutic technique. Only 9 % of them have visited a cryocentre with their dog. However, it is pleasing to note that both practitioners and owners who are familiar with cryotherapy rate its use very positively. They consider the main benefits to be faster muscle recovery, reduced inflammation, relief from muscle and joint pain and help with eczema and warts. A benefit that owners have noticed in their dogs is an increase in positive energy and mood after the application of cryotherapy.

In conclusion, cryotherapy is not sufficiently used in clinical practice, despite the benefits it provides. This is probably related to the lack of awareness and promotion of this therapeutic method among physicians as well as in general public society. The solution could be to organize popular lectures for dog owners and subscription seminars, interactive workshops with the opportunity to try out the therapeutic method for veterinarians, to raise awareness of cryotherapy and cryosurgery in society. A deeper knowledge of the positives by the general public could contribute to an increased interest of veterinarians in cryotherapy

and help them to overcome possible doubts (profitability and amount of initial financial investment) about the application of this therapeutic method in their professional practice.

## CONCLUSIONS

Cryotherapy is a non-invasive, painless, innovative method that can be used even without general anaesthesia and in places where the application of conventional treatment methods would pose a great risk. It involves treatment with cold or frost. It can be effective alone or in combination with anti-inflammatory drugs. It is a suitable alternative for older and younger patients with movement problems caused by excessive physical stress, skin defects, or tumours.

The subject of cryotherapy in our study was to monitor the trend in Slovakia and compare it with the situation in neighbouring countries. We processed the current state of cryotherapy use in practice through a questionnaire. From the results, it is clear that cryosurgery is most used in the Czech Republic in comparison with Hungary and Slovakia. Cryotherapy is used very little, despite the benefits that this therapeutic method provides. This may be due to the lack of promotion of cryotherapy among professionals and the general public.

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