JTS

The Journal of Transdisciplinary Studies, 6(2): 161-167, 2022
https://doi.org/10.22685/JTS.2022.6.2.161

A Study on the Need for Oral Care Following the Immune Aging and Dental Diseases of Old Dogs

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ARTICLE INFO

Article history:
Received 5 July 2022
Revised 22 August 2022
Accepted 22 August 2022

Keywords:
Old Dogs,
Immunity,
Dental Diseases

ABSTRACT

Dental diseases are very common among the veterinary diseases, which significantly affect the quality of life according to the interest and care thereto. In recent years, as the life expectancy of pets has increased, the interest in the care of old animals has also grown. As dogs age, their immunity changes, thereby making them vulnerable to various diseases. In particular, the incidence of dental diseases intensifies among the older dogs. In this review, the references and materials on the immune changes and major dental diseases among the old dogs were collected and presented together. Furthermore, the dogs' oral care method and effectiveness were confirmed. The dogs' immune aging arises when the thymus degenerates and the production of new cells in the bone marrow decreases. The age related changes include a decline in the cellular immune response. In addition, the major dental diseases of old dogs include periodontal disease, apical abscess, pathologic mandibular fracture, and oral tumor. The dogs' oral care may be achieved via the regular and effective home care that combines regular health check-ups and treatments. In this paper, it is intended to verify the characteristics of immunity and dental diseases of old dogs, and present the importance of dental care for the extension of healthy life expectancy of dogs.

1. Introduction

The population raising pets in Korea has consistently grown, and the companion owners are reaching 15 million in their number very soon. According to the current status of companion households and the status of raising old dogs in the 2021 Korea Companion Animal Report, there are 6.04 million households raising pets in Korea, which accounts for about 30% of the total households. In terms of area and region, the metropolitan area accounts for over half of the total, or 3.27 million households. Furthermore, when examining the parenting ratio by type of pet, dogs have ranked first, and their number was more than double that of cats, which ranked second. The pet

industry has also diversified and progressed with sophistication, while the pet industry, which had been limited to feeds and supplies, has recently expanded its scope to pet hotels, kindergartens, and funerals (Hwang & Son, 2021).

In this background, as the level of interest and care of pets has increased, the number of old pets has also increased, while the interest in extension of life expectancy such as health care and disease care according to aging has risen accordingly. Today, healthy aging has become a major concern for both the animals and humans, and it is sought to maintain and improve health through effective care methods (Bellows et al., 2015). The standards for the healthy aging of people measure various objectives and subjective aspects of the cognitive, physical, and psychological health, which include such contents as important. Aging and healthy aging among the dogs are also not very different from such human standards. This may be found in the aging studies using dogs as a research model to study the human immune aging (Cotman & Head, 2008; Mazzatenta et al., 2017; Hoffman et al., 2018).

In general, an old dog is defined as having completed 75-80% of its life expectancy. This is an even more pragmatic definition than specifying a specific age for a certain number of years, as there are large differences in terms of the life expectancy between the breeds (Hughes, 2008). According to the age calculation table for the humans and dogs presented by the Korean Animal Hospital Association, the age of a human over 65 corresponds to the age of 8-10 for the dogs depending on their breed. Furthermore, in the 2021 Korea Companion Animal Report, it may be confirmed that 10 years old corresponds to the highest percentage in the survey of the age of entering old age perceived by the companion owners (Hwang & Son, 2021).

Dogs naturally undergo many changes with age as they grow old. The dogs' immune system changes as they grow old, which makes them vulnerable to various diseases such as infectious diseases, immune diseases, and tumors throughout their lifetime (Pereira et al., 2019). In particular, dental diseases are among the most common diseases affecting the lives of dogs, with an incidence of almost 80% reported among the dogs over 3 years of age (Enlund et al., 2020).

Hence, in this paper, it is intended to verify the immune changes among the dogs due to aging and major dental diseases among the old dogs, and present the importance of dental care for the healthy aging of dogs.

2. Method

In this review, the references and materials for each item were investigated and analyzed and presented in regards to the increase in the life expectancy and aging of dogs, immune changes according to age, dental diseases among the old dogs, and the oral care methods and effects for the dogs.

3. Results

3.1 Aging and Immune Changes of the Dogs

The immune system protects one's self from the outside and is a decisive factor in one's survival. During the dogs' lifetime, the immune system plays a role in maintaining and controlling the body's health while adapting to various physiological changes. The body primarily blocks the invasion of external microorganisms through physical defense, and when an infection arises, it responds promptly based on the innate immune response (Pereira et al., 2019). Since a fetus already has a functional lymphatic system, it can act against various external antigens by using humoral and cellular immune responses since the point of birth (Day, 2007; Faldyna et al., 2005). The innate immunity and acquired immunity of newborn puppies (21 days or younger) mature as they grow up after birth, which eventually leads to a decrease in their immunity again as they grow old. Among the organs responsible for immunity, the thymus degenerates with increasing age, and such characteristic affects the changes in the immune system with age (Clarke & Kendall, 1994).

The consumption of colostrum facilitates securing such nutrients as antibodies, hormones, and growth factors along with the digestive development (Paulsen et al., 2003). Newborn puppies produce antibodies on their own in response to external pathogens as the decrease in maternal antibodies becomes apparent, and the largest increase in such antibody concentrations manifests primarily around 14-21 days of age. Based on such process, the maturation of the immune system is completed at about 6 months of age. While young puppies seem to have immunity at the age of 6-12 weeks, it is impossible to accurately predict the immune capacity at this point since they depend on the maternal antibody (Day, 2007; Chastant & Mila, 2019).

As the life expectancy increases and age increases, the immune aging arises that which increases the risk of exposure to various diseases and infectious diseases (Kraft, 1998). Immune aging is caused by various endogenous factors, such as the degeneration of the thymus and a decrease in the production of new cells in the bone marrow. The age related changes include a decline in the cellular immune response. This results when the proliferation of lymphocytes in the blood toward the immunostimulatory factor decreases. Furthermore, as the function of helper T cells decreases, the humoral immune response may tend to decrease. Older dogs demonstrate a decreased immune response to the external antigen stimuli due to the decrease of activated T cells and T cell receptors in the peripheral region (Pawelec, 2012; Day, 2010).

3.2 Major dental diseases among the old dogs

Dental diseases arising frequently among the older dogs include periodontal disease, apical abscesses, pathological mandibular fractures, and an increase in oral tumors (Niemiec, 2008b).

Periodontal disease is one of the gums and the alveolar bone under the gums as periodontal disease progresses, and once the alveolar bone is lost, it is difficult to restore it to its original conditions. Periodontal disease is caused by bacterial plaque, which begins as gingivitis in the early stages and develops into periodontitis as the disease progresses (Albuquerque et al., 2012). It is

primarily caused by the inflammation of the gums caused by plaque, and toxins produced by bacteria in the plaque cause the inflammation of the gums. When the gums become inflamed, the gums become red and swollen, and very often, when one brushes one's teeth, the gums bleed and one's mouth smells bad.

Periodontal disease is most commonly diagnosed in the clinical practice for small species, and in most cases, demonstrates little clinical symptoms during the course of the disease, and is treated later after the disease has progressed much over time. Consequently, periodontal disease is among the most untreated diseases in the animal health care (Niemiec, 2008b). The diagnosis of periodontal disease is primarily based on the visual evaluation, and the disease's occurrence may be confirmed by 9.3-18.2% of the total. However, when accurately diagnosed under sedation or anesthesia, it has a high incidence of 44-100%, respectively (Hoffman & Gaengler, 1996).

The occurrence or severity of periodontal disease varies depending on the size, breed, and individual differences of the dogs. According to the clinical data, it was confirmed that the periodontal disease which had progressed as the age increased was manifested, and the periodontal disease worsened in proportion to the weight loss. The disease tended to arise first in the upper and lower incisors, the fourth premolars and the first molars. While diet, behavior, environment, and genes play a role in the occurrence of periodontal disease, it can act as the worst factor in terms of the disease development when the oral care is not properly performed (Wallis & Holcombe, 2020).

Apical abscess is a disease in which inflammation arises around the root of the tooth, causing the abscess to form around the tip of the tooth and dissolving the alveolar bone. The pain is severe and swelling around the root of the tooth manifests, yet when the inflammation intensifies, a pustule is formed to penetrate into the skin. It is a disease which is difficult to treat medically and is easy to recur. The inflammation treatment after tooth extraction is recommended as the most effective treatment. Apical abscess is a common disease among the old dogs without the dental care, which primarily arises in the fourth premolar of the maxilla. This is the most important tooth for chewing, and when extracted for treatment, a functionally important tooth is lost. To prevent the apical abscess, it is necessary to maintain the guardian's regular dental care, as well as the regular oral examinations and scaling care (Kim, 2013).

Pathological fractures of the mandible among the dogs arise primarily among the old dogs, or when the periodontal bone is lost due to severe periodontitis that is not managed, and is also caused by tumors, tooth extractions, and osteoporosis. Since pathological fractures are difficult to overcome surgically and recovery is quite challenging even after the orthodontic treatment is completed, the problematic tooth is excised and the missing part of the periodontal bone and mandible is filled with the additional artificial bone materials. Periodontitis among the old dogs is a very common disease, and if the periodontal bone is damaged due to severe damages, even a small impact may cause fractures thereby (Kim, 2012; Shim et al., 2007).

Oral tumors account for about 3.4% of all tumors arising among the dogs, and are also the fourth most common tumor. Among the oral tumors that arise primarily among the dogs, benign tumors include gingivoma, and malignant tumors include malignant melanoma, squamous cell carcinoma, and fibrosarcoma, respectively. The treatment of oral tumors is consisted of surgical excision of the tumor and radiation therapy. In the case of the tumors with invasion to the bone, a wide

range of jaw resection may be performed. In recent years, as the incidence of tumors increases with the aging of dogs, the interest in the treatment and prognosis for oral tumors as a major dental disease has largely grown (Park et al., 2009).

3.3 Oral Care for Pet Dogs

The purpose of the prevention and treatment of periodontal disease is to maintain the clinically healthy teeth by preventing the inflammation by preventing plaques from accumulating on the tooth surface (Wallis & Holcombe, 2020; Lindhe et al., 1975; Harvey, 1998).

For the dogs' oral health, the owners' home care may bring about an important effect. Brushing is one of the most effective ways to remove plaque (Gorrel & Rawlings, 1996; Niemiec, 2008a). The teeth chewing toys can also help prevent plaque and tartar from against buildups (Harvey & Shofer, 1996). Furthermore, the oral care of dogs is important for the early detection of diseases through the regular check-ups and continuous attention as well as the observation of their owners. Once formed, the tartar cannot be removed without a professional dental care under anesthesia.

Hence, the dogs' oral health may be protected based on the regular and effective home care combining the regular health check-ups and treatments.

4. Conclusion

In Korea's pet industry, the aging rate of pets is increasing along with the changes in the people's lifestyles, and the interest is increasingly focused on improving the health and quality of life for such old animals.

During the dogs' lifetime, the immune system plays the role of maintaining and controlling the body's health while adapting to various physiological changes. With aging, the immune function declines and various diseases arise. In particular, dental disease is one which tends to increase as the life expectancy of dog is extended.

The care and treatment of dental diseases require intensive care from 3 years of age and older, with a reported incidence of nearly 80% among the dogs. It is necessary to inform on the problems which might arise due to dental diseases via the owners' education, and emphasize that the owners' home care has an important effect for the oral health of dogs. The dogs' oral health may be cared for by the brushing habit and continuous monitoring through the home care. Based on which, it may be expected to have an important effect on extending a healthy life expectancy and improving the quality of life through the disease care of dogs.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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