Skin and gut microbiome analysis offers new therapeutic perspectives on atopic dermatitis in Shiba Inu dogs

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Shiba Inu dog. These dogs are prone to canine atopic dermatitis. Credit: Misa Hirose, private photo.

Complex diseases—including cancer, metabolic diseases and allergies—affect not only humans, but also domestic animals, such as dogs. Approximately 10% of the dog population suffers from canine atopic dermatitis (cAD). This well-known common disease in dogs is characterized by excessive pruritis (itchiness) and is caused by allergy to environmental allergens, such as pollens and mites.

The etiology of cAD is complex, and the disease is thought to be affected by multiple factors such as host genetics and environmental factors. There is no curative treatment for cAD and it requires life-long treatment to maintain an acceptable quality of "canine" life. Such conditions of dogs also have significant impact on their owners—physically, mentally and financially. Therefore, better and more effective therapeutic options and/or management of cAD are urgently needed to improve the overall well-being of both dogs and their owners.

Microbes have recently gained significant attention due to their crucial role and therapeutic potential in addressing common complex diseases, such as atopic dermatitis in humans. Dysbiosis (imbalance in the community of microbes) in the skin has been the most well-addressed in human AD patients.

Scientists from the Lübeck Institute of Experimental Dermatology at the University of Lübeck, together with colleagues at Tokyo University of Agriculture and Technologies and Royal Canine SAS, have systematically described compositions of microbes residing on the skin and in the gut from adult Shiba Inu dogs.

The study is published in the journal *Microbiome*.

Shiba Inu is a canine breed known to be highly susceptible to cAD, particularly in Japan. To analyze the microbiome, researchers took skin

swab samples from 12 skin sites per dog in addition to stool samples from four different Shiba Inu dog groups; (1) newly diagnosed cAD dogs without treatment, (2) the same cAD dogs after receiving Janus kinase antagonist (oclacitinib; Apoquel) for 2 weeks (0.4-0.6 mg/kg, twice daily), (3) cAD dogs with long-term oclacitinib treatment (0.4-0.6 mg/kg, once a day) and (4) healthy dogs, and profiled the bacterial composition by using bacterial 16S rRNA gene sequencing.

With this experimental design, they compared the microbiome of cAD-affected dogs to that of healthy dogs, and evaluated the impact of treatment with oclacitinib on the changes in the microbiota. Apoquel is a veterinary used drug to treat pruritis associated with allergic skin inflammation including cAD, and it blocks the action of enzymes Janus kinases, which mediate itchiness and the inflammation.

The most prominent finding of the study is that Fusobacteria and Megamonas are highly abundant in healthy dogs but significantly reduced in cAD-affected dogs. After cAD-affected dogs received oclacitinib, this bacterial abundance in their systems reverted towards the levels of that found in healthy dogs. Interestingly, the change of the microbiota caused by the treatment was more prominent in the gut than that on the skin.

These results indicate that microbes serve as potential therapeutic targets and biomarkers for cAD. In addition, the researchers performed canine whole mitochondrial DNA sequencing of buccal swab samples obtained from the dogs. For the first time, this study revealed an association of dog mitochondrial haplogroups, i.e., a combination of genetic variations in the mitochondrial DNA, with specific bacterial taxa in the skin and gut.

The researchers are confident that these findings will be used as a basis for novel disease management strategies for cAD, for example, by

developing a novel dietary intervention to reduce cAD-associated bacteria and to promote bacteria associated with healthy dogs. New biomarkers, such as specific microbiota, will help to evaluate cAD predisposition, treatment efficacy and health management in dogs.

More information: Mirja Thomsen et al, A comprehensive analysis of gut and skin microbiota in canine atopic dermatitis in Shiba Inu dogs, *Microbiome* (2023). DOI: 10.1186/s40168-023-01671-2

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