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Treatment with nanostructures in dog with Alopecia X

Tratamiento con nanoestructuras en un perro con Alopecia X

Tratamento com nanoestruturas em cão com Alopecia X

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Resumen

La alopecia se considera una patología no inflamatoria, sin signos sistémicos, caracterizada por la detencion del ciclo de crecimiento del pelo, que es común en los pomeranos y puede ocurrir en otras razas. Se observó una hembra de raza Pomerania castrada y sana con detención del ciclo capilar confirmada por alopecia X y sequedad de la piel. El tratamiento consistió en una formulación de laca para el cabello compuesta por factores de crecimiento fisiológicamente equilibrados en una solución a base de agua y sin alcohol, con el propósito de estimular el folículo piloso y, en consecuencia, el crecimiento del cabello. Para el tratamiento de la piel seca se seleccionó otra composición de principios activos hidratantes y nutritivos. Esta prometedora terapia es fácil de administrar, no tiene efectos secundarios y es de bajo costo, surgiendo como una alternativa a las terapias que causan traumatismos en la piel y la administración de medicamentos sistémicos, que muchas veces no tienen éxito.

Palabras clave: Alopecia X, Growth factors, Nano copper peptide

Abstract

Alopecia X is considered a non-inflammatory pathology, without systemic signs, characterized by the arrest of the hair cycle, common in the Pomeranians, but may occur in other breeds. A healthy, neutered Pomeranian female was treated with hair cycle arrest confirmed for alopecia X and skin dryness. The treatment

consisted of a hair spray formulation composed of physiologically balanced growth factors in an alcohol-free aqueous-based solution, with the purpose of stimulating the hair follicle and consequently hair growth. Another composition of moisturizing and nourishing active ingredients was selected for the treatment of dry skin. This promising therapy is easy to administer, has no side effects and is low cost, emerging as an alternative to therapies that cause skin trauma and administration of systemic medications, often without success.

Keywords: Alopecia X, Growth factors, Nano copper peptide

Resumo

Alopecia X é considerada uma patologia não inflamatória, sem sinais sistêmicos, caracterizada pela parada do ciclo de crescimento capilar frequente em pomeranos, podendo ocorrer em outras raças. Uma fêmea saudável e castrada da raça Pomerania foi atendida com parada do ciclo capilar confirmada para Alopecia X e ressecamento cutâneo. O tratamento consistiu em uma formulação spray capilar composta por fatores de crescimento fisiologicamente balanceados em solução de base aquosa, livre de álcool, com a finalidade de estimular o folículo piloso, consequentemente, o crescimento dos pelos. Outra composição de ativos hidratantes e nutritivos foram selecionados para o tratamento do ressecamento cutâneo. Essa terapia promissora é de fácil administração, sem efeitos colaterais e de baixo custo, surgindo como uma alternativa às terapias que acarretam traumas cutâneos e administração de medicações de ação sistêmica, muitas vezes sem sucesso.

Palavras chave: Alopecia X, Growth factors, Nano copper peptide

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Introduction

The arrest of the hair cycle, known as Alopecia X, is defined as a non-inflammatory skin manifestation in dogs, with an unknown pathogenesis. It most frequently affects the areas of the trunk, tail, thighs, perineum and neck, while the head is generally not affected. The main clinical finding is a stop in hair growth, dull coat that sheds easily, followed by melanoderma, dry skin, and systemic signs are absent [1-4].

The behavior of the hair follicle, as an integral part of the skin, is controlled by complex pathways between balanced pathophysiological signals in its microenvironment demonstrated by the phases: anagen, telogen, catagen and neogen [5,6]. Genetic, immunological, hormonal and environmental factors cause the animal to be covered in hair at all times, protecting the skin from ultraviolet radiation, andcontrolling body temperature, in addition to stimuli on the sensation of touch [7,8].

Growth factors (GFs) are groups of proteins that bind to specific surface receptors, stimulating tissue growth through interaction in cell division, and controlling cell

growth, proliferation and differentiation through intracellular and intercellular signaling pathways [9]. Currently, the identified GFs that participate in the anagen phase are IGF-1 (insulin growth factor type 1), KGF (keratinocyte growth factor), VEGF (vascular endothelial growth factor), FGF-2 and 18 (fibroblast growth factors type 2 and 18), aFGF (acidic fibroblast growth factor) and bFGF (basic fibroblast growth factor). Those that suppress the growth and differentiation of a follicle in the telogen and catagen phases are EGF (epidermal growth factor), TGF-β3 (transforming growth factor), FGF-5 (fibroblast growth factor type 5) [9-11].

The selection of GFs used in treating of the patient in this case report was based on data from human medicine and studies from the cosmetics industry. This article aims to demonstrate the efficacy of this combination of nanostructures in accelerating follicular metabolism through synergy with cytokines and skin reconstitution providing stimulation and proliferation of fibroblasts, keratinocytes and collagen secretion.

Case Report

A female, neutered, 8-year-old Pomeranian dog was treated at a private clinic. The owner reported that the patient had an absent and irregular coat on the chest, abdomen, and tail, and a partial coat on the head, neck and paws, since she was five years old, and skin dryness had recently started. Firstly, the patient was assisted by another veterinarian at the beginning of the hair loss. Hematological and endocrine tests were performed, showing no changes. A skin biopsy was performed with a diagnosis suggestive of Alopecia X. The owner did not accept the recommended microneedling treatment and continued only with moisturizing baths for three years. During the clinical examination, dry skin was observed in the alopecia areas and there was no pruritus. Parameters such as temperature, mucosal color, capillary refill time, hydration, cardiopulmonary auscultation, as well as lymph node palpation, were within normal limits. New hematological and biochemical tests were performed (alanine aminotransferase, alkaline phosphatase, amylase, total proteins and fractions, urea, creatinine, cholesterol, triglycerides, ionic calcium, phosphorus, potassium, cortisol, thyroid-stimulating hormone, triiodothyronine and thyroxine), and no changes were observed in these tests. A topical spray was indicated with the combined composition of the nano encapsulated growth factors: bFGF 1%, VEGF 1%, IGF 1% and nano copper peptide 1%, incorporated in a non-alcoholic aqueous base, applied to the entire body at night for 40 days. In addition, a compounded spray containing 1% D-panthenol, 2% hydroviton, 2% vitamin E and 3% aloe vera tincture, in non-alcoholic aqueous base, was applied to the skin of the entire body in the morning for the same period. A compounded moisturizing shampoo containing 2% jaborandi tincture, 2% colloidal oatmeal, 0.1% tea tree essential oil and 3% chamomile extract in a hypoallergenic base with a pH compatible with the animals' skin was prescribed every seven days. After 40 days of starting treatment, the patient was reevaluated and showed significant hair and under-hair growth (Figure 1). The skin had a soft and hydrated sensory appearance, as evidenced by the touch and the absence of dryness. No adverse changes were observed. The treatment was continued for four

months in a row, resulting in complete coverage of the alopecic areas. Four years after the prescribed treatment, the patient was reevaluated again and still presentes a complete hair coat, and no complications.

Figure 1. Response to treatment with nanoencapsulation of bioactivities. (a) Before treatment. (b) Forty days of treatment. (c) Four months of treatment. (d) Dog after four years of treatment.

Result and discussion

Topical treatment with physiologically balanced GFs and nano copper peptide in the canine patient showed that it is possible to activate the hair follicle cycle, reversing follicular atrophy, presented with a complete hair coat, in addition to improving dermal disorders, due to the fragility of the absence of hair as a protective factor, without causing adverse reactions and painful trauma to the skin.

The involvement of the synergistic interaction of multiple GFs demonstrates positive results in the processes that promote skin repair and hair growth [12]. It is believed that variations in the type of coat that the animal presents, whether fine and short, fine and long, presence or absence of an undercoat, should be considered in relation to the growth time [13,14]. The type of coat of this patient was fine, relatively long and had a dense undercoat.

The choice of this therapy was based on the activity that GFs naturally exert in the follicular microenvironment [15]. Although the reason that leads to alopecia in animals is not well understood, it is possible that topical application, in a certain way, activated specific cell receptors, causing stimulation of endogenous GFs and, consequently, reversal of hair growth arrest. IGF-1, with the property of improving cell migration, survival and proliferation; VEGF stimulating perifollicular angiogenesis, increasing the availability of oxygen and nutrients for hair bulb cells; bFGF acting on the advancement of hair follicles [9]; and the nano copper peptide, due to its anti-5-α-reductase action, induced by the hormone dihydrotestosterone (DHT), individually or not, may help in reversing follicular atrophy in this patient [6]. To observe and improve therapeutic efficacy, an aqueous base, free of parabens, petrolatum and alcohol was chosen to incorporate the nanostructured ingredients. Nanoencapsulation allows the controlled and targeted release of nutrients and biological compounds [16].

There are reports in the literature of hair growth using the micro-needling technique, which uses fine-gauge needles that cause micro-trauma to the skin, to cause forced stimulation of the hair follicles [4]. However, to apply this technique to animals, it is necessary to subject the patient to general anesthesia or deep sedation, followed by systemic treatment with analgesics, antipyretics, antimicrobials and baths with antiseptic shampoos. The limiting factors present varied results, such as relapses in hair loss after a short period, disparity in growth in the affected areas, failure to grow, and skin contamination, in addition to the possibility of causing gastrointestinal and renal problems triggered by the administration of medications.

Conclusion

In this case report, there was no recurrence of the Alopecia X condition. After four years from the start of treatment, complete hair coverage is maintained, which ensures the effectiveness of specific topical therapy for a long time. Therefore, growth factors as key molecules in understanding disorders involving hair development, should be considered as an option in the treatment of alopecic disorders in animals, providing new strategies for targeted study and development of therapeutic products.

References

1. Albanese F, Malerba E, Abramo F, Miragliotta V, Fracassi F. Deslorelin for the treatment of hair cycle arrest in intact male dogs. Vet Dermatol. 2014, 25(6), 519-e88.
2. Cerundolo R, Lloyd DH, Persechino A, Evans H, Cauvin A. Treatment of canine Alopecia X with trilostane. Vet Dermatol. 2004, 15(5), 285-293.
3. Müntener T, Doherr MG, Guscetti F, Suter MM, Welle MM. The canine hair cycle - a guide for the assessment of morphological and immunohistochemical criteria. Vet Dermatol. 2011, 22(5):383-95.
4. Stoll S., Dietlin C. & Nett-Mettler C.S. Microneedling as a successful treatment for alopecia X in two Pomeranian siblings. Vet Dermatol. 2015, 26:387-e88.
5. Bernard BA. Advances in understanding hair growth. F1000 Research. 2016, 8;5:147
6. Tampucci S, Paganini V, Burgalassi S, Chetoni P, Monti D. Nanostructured drug delivery systems for targeting 5-α-reductase inhibitors to the hair follicle. Pharmaceutics. 2022, 14(2):286.
7. Brunner MAT, Jagannathan V, Waluk DP, Roosje P, Linek M, Panakova L, Leeb T, Wiener DJ, Welle MM. Novel insights into the pathways regulating the canine hair cycle and their deregulation in Alopecia X. PloS One. 2017, 24;12(10):e0186469
8. Mausberg EM, Drögemüller C, Dolf G, Leeb T, Rüfenacht S, Welle MM. Evaluation of the CTSL2 gene as a candidate gene for Alopecia X in Pomeranians and Keeshonden. Anim. Biotechnol. 2007, 18(4),291–296.
9. Wang Z. Regulation of cell cycle progression by growth factor-induced cell signaling. Cells. 2021, 26;10(12):3327.
10. Moore GP, Du Cros DL, Isaacs K, Pisansarakit P, Wynn PC. Hair growth induction: roles of growth factors. Ann N Y Acad. Sci. 1991, 26:642:308-25.
11. Weger N, Schlake T. IGF-I signalling controls the hair growth cycle and the differentiation of hair shafts. J Invest Dermatol. 2005, 125(5), 873-882.
12. Chen CL, WY, Wang EHC, Tai KY, Lin SJ. Functional complexity of hair follicle stem cell niche and therapeutic targeting of niche dysfunction for hair regeneration. J Biomed Sci. 2020, 27(1):43.
13. Müntener T, Schuepbach-Regula G, Frank L, Rüfenacht S, Welle MM. Canine noninflammatory alopecia: a comprehensive evaluation of common and distinguishing histological characteristics. Vet Dermatol. 2012, 23(3):206-e44.
14. Gavazzoni K, Marra L, Ferrarini E, Kaltbach V. Use of topic growth factors and minoxidil sulfate in a female dog with black hair follicular dysplasia. 9th World Congress of Veterinary Dermatology; 2020, Sydney, AUS: Vet Dermatol, 31(S1):p1-112(105).
15. Peus D, Pittelkow MR. Growth factors in hair organ development and the hair growth cycle. Dermatol Clin. 1996,14(4):559-72.
16. Awuchi CG, Morya S, Dendegh TA, Okpala CO, Korzeniowska M. Nanoencapsulation of food bioactive constituents and its associated processes: A revisit. Bioresour. Technol. 2022, 19, 101088.

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