ESTONIAN UNIVERSITY OF LIFE SCIENCES
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OWNER COMPLIANCE WITH TREATMENT GUIDELINES FOR ATOPIC DERMATITIS IN DOGS

OMANIKUPOOLNE RAVIJUHISTE TÄITMINE KOERTE ATOOPILISE DERMATIIDID KORRAL

Final Thesis
Curriculum in Veterinary Medicine

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Abstract: This research explains different treatment options for dogs having atopic dermatitis and attempts to understand what treatment options owners prefer, is there a correlation with the treatment option being chose, time of the diagnosis, treatment difficulties and owners education level, and what aspects owners find to be challenging in the treatment of canine atopic dermatitis. The study was conducted in the form of a questionnaire handed to the owners visiting dermatologist at the small animal hospital of Estonian University of Life Sciences with their dogs diagnosed with canine atopic dermatitis. The period of collecting the answers was from December 2022 to April 2023. Best short-term treatments are glucocorticoids and oclacitinib. For chronic symptoms allergen specific immunotherapy, lokivetmab and oclacitinib has shown to be a highly effective. Cyclosporine and recombinant interferons are also good alternatives for chronic treatment. Most common adverse effects of these medications are vomiting, diarrhea, polyuria, polydipsia and on some cases increased pruritus mostly at the start of the treatment. The study found that only the owners having a dog diagnosed with canine atopic dermatitis less than a year ago and having a higher education chose allergen specific immunotherapy. Treatment costs were the most challenging aspect for all the owners, second most common challenge was regular veterinary visits. Oclacitinib, allergen specific immunotherapy and lokivetmab were the most common treatment options. Most predisposed dog breeds were French bulldogs and German shepherds. Most of the dogs visited the dermatologist once a month.

Keywords: treatment, caregiver burden, treatment challenges, questionnaire

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Abstrakt: Antud uurimus selgitab erinevaid ravivariante atoopilise dermatiidi diagnoosiga koertel ning üritab aru saada, milliseid ravimeetodeid eelistavad omanikud. Uuritakse, kas on seos ravivalikute, diagnoosimise ajalisuse, raviskeemist kinnipidamise ja omanike haridusliku taseme vahel ning missuguseid aspekte omanikud atoopilise dermatiidiga koera ravis keeruliseks peavad. Uurimus viidi läbi küsimustiku vormis Maaülikooli Väikeloomakliiniku dermatoloogi visiidil viibivate omanike seas. Kõigil uuringus olevatel koertel oli diagnoositud atoopiline dermatiit. Andmeid koguti perioodil detsembrist 2022 aprillini 2023. Parimad lühiajalise ravi valikud on glükokortikosteroidid ja oklatsitiniib. Krooniliste sümptomite raviks on efektiivsed allergeen-spetsiifiline immunoteraapia, lokivetmab ja oklatsitiniib. Tsüklosporiin ja rekombinantsed interferoonid on ka heaks alternatiiviks kroonilistel juhtudel. Enamlevinumad kõrvaltoimed nendele ravimitele on oksendamine, kõhulahtisus, polüdipsia, polüuuria ning mõnel juhul suurenenud sügelus ravi alguses. Uuringust selgus, et ainult omanikud, kellel oli kõrgem haridustase ja kelle loomal oli atoopiline dermatiit diagnoositud viimase aasta sees, valisid allergeenspetsiifilise immuntoeraapia. Kõige keerulisemaks aspektiks hindasid omanikud ravimite maksumust, teiseks keeruliseksnüansiks osutusid regulaarsed visiidid loomakliinikusse. Oklatsitiniib, allergeenspetsiifiline immunoteraapia ja lokivetmab olid kõige levinumad ravivariandid. Suurima eelsoodumusega tõugudeks leiti olevat prantsuse buldog ja saksa lambakoer. Enamus koeri käis dermatoloogi visiidil kord kuus.

Märksõnad: ravi, hooldaja koorem, ravi väljakutseid, küsimustik

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LIST OF ABBREVIATIONS

BID - twice a day

CAD - canine atopic dermatitis

H1 - histamine receptor 1

H2 - histamine receptor 2

IgE - immunoglobulin E

PO - per os

SID - once a day

INTRODUCTION

Treatment of canine atopic dermatitis can be challenging as the exact cause of the disease is not well understood and each dog needs a specifically designed treatment for their different needs and the treatment can vary a lot depending on the owners' financial capabilities (Saridomichelakis and Olivry, 2015). Owners often experience a caregiver burden when having a dog with skin diseases, the more complex the treatment plan is and the more severe the skin symptoms are the higher the caregiver burden is. Altogether treatment and care of a dog with canine atopic dermatitis is very straining to the owners (Spitznagel et al., 2021).

This research wanted to understand better the owners' compliance on selecting the treatment options and conclude what they felt the most challenging in the treatment and whether they felt the treatment management being easy or difficult. Since the disease is challenging to manage it is important to understand the owners' burden and compliance because it affects the outcome of the treatment.

The research was made as a survey based on the data from questionnaires given to the owners of dogs with atopic dermatitis who visited the dermatologist at the small animal hospital of Estonian University of Life Sciences.

1. LITERATURE REVIEW

1.1. Canine atopic dermatitis

Canine atopic dermatitis (CAD) is a common allergic skin disease of dogs of all breeds. CAD is suggested to have a genetic predisposition. Canine atopic dermatitis causes skin inflammation and pruritus usually requiring a life-long treatment (Nuttall et al., 2013).

1.2. Prevalence

The prevalence of canine atopic dermatitis in general dog population is 3-15 % and among dog with skin diseases, the CAD covers up to 58 % of the cases (Santoro, 2019). The most predisposed breeds to have a CAD are golden retrievers, labradors, West Highland white terriers, English springer spaniels, French bulldogs, bull terriers, Tibetan terriers, and bichon frisé, whereas mixed breed dogs have the lowest occurrence. Depending on the geographical location the most presented breeds vary a little (Nuttall et al., 2013 and Santoro, 2019). Common age when the symptoms occur is between 6 months to 6 years, although over 70 % of the cases occur between 1-3 years of age (Santoro, 2019).

1.3. Clinical signs

The main clinical signs are pruritus, erythema, excoriation, and skin lesions on different areas of the body. Lesions includes papules, pustules, and crusts. The pruritus can be seasonal, non-seasonal or non-seasonal but with signs worsening seasonally. The most common affected areas are around mouth and eyes, in the ears, elbows, carpus and tarsus, paws, ventral abdomen, perineum and ventral aspect of the base of tail (Saridomichelakis and Olivry, 2016; Santoro, 2019).

1.4. Causative factors

Bizikova et al. (2015) explained in their review article that numerous research has concluded genetic and environmental factors together playing an important part in pathogenesis of canine atopic dermatitis. The exact mechanisms have not yet been found but researchers have been able to conduct over time more information and a clearer understanding of the pathogenesis of CAD.

1.4.1. Genetics

Genetic predisposition has been found as an important factor in pathogenesis of CAD. The exact mechanism however is still not clear. With certain dog breeds been predisposed to develop CAD, genetics clearly show an important part (Bizikova et al., 2015). Hillier and Griffin (2001) suggested in their review article canine atopic dermatitis being genetically inheritable by a dominant way.

1.4.2. Environmental factors

Possible environmental factors predisposing canines to CAD includes, house dust mites, storage mites, proteases, toll-like receptor interactions, parasites and endotoxins and other bacterial and fungal components. None of those factors had been completely accepted to be a major cause to launch CAD, however studies conducted with humans with atopic dermatitis has shown a correlation with these factors (Hill and DeBoer, 2001; Bizikova et al., 2015).

1.5. Diagnostics

1.5.1. Excluding other skin diseases

The diagnosis of CAD is mainly based on ongoing symptoms and by excluding other skin diseases caused by fleas, *Sarcoptes scabiei*, *Cheyletiella*, *Demodex, Otodectes cynotis*, Staphylococcal infection or overgrowth of Malassezia and cutaneous adverse food reactions (DeBoer and Hillier, 2001; Hensel et al., 2015).

1.5.2. Intradermal skin testing and Immunoglobulin E serology testing

Intradermal skin testing against environmental allergens and Immunoglobulin E (IgE) serology test used to be recommended on some cases of CAD, but in recent studies have found that also dogs with other skin diseases than CAD or even healthy dogs can react positively to intradermal skin reactions against environmental allergens or have a detectable IgE -levels. Therefore, these tests should not be used to diagnose canine atopic dermatitis. Intradermal skin testing and IgE serology testing are useful when already diagnosed atopic dog will undergo allergen specific immunotherapy to find the allergens that causes the symptoms for this specific dog (Tarpataki, 2008; Olivry et al., 2015; Mueller, 2019).

1.6. Caregiver burden

Since canine atopic dermatitis is a life-long disease with multiple symptoms with varying severities and difficult to diagnose and treat with great financial burden owners may exhibit

increased caregiver burden taking care of their animals. In a study conducted by Spitznagel et al. (2019) caregiver burden among dermatology patients' owners were significantly higher than in control group with healthy patients without skin diseases. The more severe the skin symptoms were the greater the caregiver burden was. Owners having the disease well-controlled experienced lower burden. Noli et al. (2011a; 2011b) found out in their study of quality of life of dermatology patients and their owners that owners and their dogs' quality of life improved after treatment for skin disease was started. With dogs their normal behavior was negatively changed before treatment and greatly improved after the treatment. Owners experienced physical exhaustion, time loss, emotional distress, and negative impact on family relationships before treatment was started for their dogs and these aspects improved positively after the treatment.

1.7. Treatment

Treatment of canine atopic dermatitis varies a lot depending on the individual dogs' needs and whether we are treating acute or chronic symptoms. It also varies depending on the owners' financial status and compliance. The ideal treatment is simple, effective, and easy for the owner to manage thus reducing the caregiver burden of the owners (Spitznagel et al., 2021). In the Table 1 are listed the drug options to treat the acute symptoms and in Table 2 are shown drugs for chronic symptoms. These tables differentiate the dosages, duration, and whether it is an effective or non-effective drug against symptoms of CAD.

Table 1. Dosage, duration, and efficacy of drugs used to treat acute symptoms of canine atopic dermatitis.

Drug	**Dosage**	**Duration**	**Efficacy**
Systemic glucocorticoids	0.5mg/kg Glucocorticoids SID/BID	Until skin symptoms have resolved, then taper the drug down	Highly effective option for acute CAD
Topical glucocorticoids	Topical application	Preferably SID on two consecutive days a per week	Good with localized lesions

Oclacitinib	0.4-0.6 mg/kg BID 2 weeks, then SID for maintenance	Short -and long-term use recommended	Highly effective
Antihistamines	Hydroxyzine 2mg/kg BID PO OR Cetirizine 1mg/kg SID PO	Long-term treatment	Not so effective, could be good to combine with other medications

Table 2. Dosage, duration, and efficacy of drugs used to treat chronic symptoms of canine atopic dermatitis.

Drug	**Dosage**	**Duration**	**Efficacy**
Systemic glucocorticoids	0.5mg/kg SID/BID	After remissions taper down to lowest effective dose	Effective but possess many adverse effects long term
Topical glucocorticoids	Applied topically SID until remission	After remission twice a week on consecutive days, can be tried to reduce the application frequency even more	Effective if localized lesions
Ciclosporin	5mg/kg SID until remission occurs the lower to smallest effective dose	After remission taper down to the lowest effective dose for maintenance	Effective on long-term
Oclacitinic	04-0.6mg/kg BID for 2 weeks then maintenance SID	Short -and long-term use recommended	Effective

Recombinant interferons	5,000-10,000 units/kg	3 times a week for 4 weeks, then once a week	Can be effective
Allergen-specific immunotherapy	Not one specific dosage	Must be treated over a year to evaluate efficacy, injection every four weeks usually	Effective
Lokivetmab	1mg/kg (in Europe)	Every four weeks usually	Effective

1.7.1. Treatment of acute symptoms of canine atopic dermatitis

1.7.1.1. Glucocorticoids

For acute symptoms of pruritus and lesions, a short-term treatment with topical glucocorticoids (e.g., hydrocortisone aceponate) is very efficient option. With severe symptoms, when topical treatment is not providing desirable results, oral glucocorticoids can be used short-term. Prednisolone, prednisone, and methylprednisolone are the drugs of choice to use as a short-term oral treatment. It is highly not recommended to use glucocorticoids long-term considered the adverse effects (Olivry and Sousa, 2001; Nam et al., 2012; Bruet et al., 2022).

The adverse effects of oral glucocorticoids include polyuria, polydipsia, obesity, muscle and skin atrophy, polyphagia, bacterial and fungal infections, behavioral changes, demodicosis and iatrogenic hyperadrenocorticism (Olivry and Sousa, 2001; Saridomichelakis and Olivry, 2016). In a study conducted by Nuttall et al. (2009) no adverse effects were documented when dogs were treated with topical hydrocortisone aceponate (Cortavance) less than 70 days total. Glucocorticoids are contraindicated if the patient has diabetes mellitus, demodicosis or severe infections (Gortel, 2018).

The local glucocorticoids are a good alternative to systemic glucocorticoids if the skin lesions are localized and easy to treat with topical products. With more generalized symptoms use of topical products would be more challenging and costly to the owners (Saridomichelakis and Olivry, 2016).

1.7.1.2. Oclacitinib

Oral short-term treatment with oclacitinib (Apoquel) is very effective treatment on most dogs against pruritus. It acts by inhibiting Janus kinase which is a signal transducer and activator of transcription signaling pathway JAK-STAT. By inhibiting Janus kinase, less cytokines are passing the pathway thus minimizing the inflammatory response (Gadeyne et al., 2014; Gonzales et al., 2014; Denti et al., 2022).

When combining oclacitinib and long-term systemic glucocorticoid treatment there is an increased risk for a potential dose-dependent drug induced immunosuppression which can predispose the dog to develop severe opportunistic infections of the skin and other organs (Olivry et al., 2015).

There are no major adverse effects found if oclacitinib is only used short-term. When used long-term, oclacitinib medication can cause more adverse effects including cystitis, gastrointestinal signs as vomiting, anorexia and diarrhea and possible skin infections. Patients with cancer or suspicion of cancer should avoid oclacitinib since it may exacerbate the condition of the cancer. Oclacitinib is also not recommended if the patient has ongoing or recent demodicosis because the demodicosis can exacerbate. Dogs younger than twelve months of age should be treated with other medication than oclacitinib. If dog is having a serious infection as pneumonia, the infections should be treated first before starting oclacitinib treatment (Gadeyne et al., 2014; Cosgrove et al., 2015). Some patients may have increased pruritus and appearance of clinical lesions when the dose is reduced from twice a day to once a day. In biochemistry parameters increased serum cholesterol and alkaline phosphatase levels can be seen when using oclacitinib. In hematology parameters minimal leukopenia is possible (Gadeyne et al., 2014; Denti et al., 2022).

1.7.1.3. Washing of skin and coat

To relief acute pruritus especially with mild CAD, washing the skin and fur with emollient formulations containing antiseptics, lipids and complex sugars or containing raspberry oil, lipids and phytosphingosine have shown to have good outcome (Popa et al., 2012; Bensignor et al., 2013; Olivry et al., 2015).

1.7.1.4. Antihistamines and essential fatty acids

There is likely no major benefit to treat acute CAD symptoms with antihistamines or essential fatty acids as their onset of action take long time to occur. If antihistamine is tried, oral use of type 1 antihistamine is used and it may improve the symptoms, but the overall efficacy is poor (Cook et al., 2004; Popa et al., 2011).

Antihistamine works as an antagonist for histamine receptors. Most important histamine receptor regarding CAD are H1 and H2 receptors. Antihistamines helps with histamine-induced pruritus, increased vascular permeability and pain (DeBoer and Griffin, 2001). Histamine is not the major mediator for cutaneous inflammation and pruritus in canine atopic dermatitis. Once histamine is already released in the body and bound to receptors due to flare up of skin symptoms, antihistamine cannot work after that (Saridomichelakis and Olivry, 2016).

Essential fatty acids can help improve the condition of skin when used long-term (Popa et al., 2011).

1.7.2. Treatment of chronic canine atopic dermatitis

1.7.2.1. Identification of causative factors

It is important to try to identify and remove possible allergenic factors causing the symptoms; for example, keeping the living conditions of the dog clean to prevent dust mites and storage mites, using ectoparasitic treatments, or changing the diet to see if that was causing the symptoms (Hill and DeBoer, 2001).

1.7.2.2. Ectoparasitic treatment

Olivry et al. (2015) explained in case of dogs with atopic dermatitis it is extremely important to treat dogs against ectoparasites regularly as the parasites can cause flare ups of the symptoms. If the dog has shampooed a lot to relieve the skin symptoms, systematic and oral ectoparasitic treatments are more recommended than topical ones.

1.7.2.3. Food trials

Olivry et al. (2015) suggested if the dog has non-seasonal symptoms, it is advisable to trial with dietary restriction-provocation diet, also called an elimination diet to exclude possible adverse food reactions. The elimination diet consists of feeding only novel or hydrolyzed diet first two months and if symptoms disappear, then adding one by one the original feed to the diet to see if it causes relapse of symptoms.

1.7.2.4. Antimicrobial therapy

Olivry and Mueller (2003) explained that with canine atopic dermatitis, there can be a secondary bacterial or fungal skin and ear infections where topical or systemic antimicrobial therapy is indicated. Antibiotics as tetracycline-niacinamide, doxycycline and erythromycin can be used. There is no efficacy on using antibiotics to treat pruritus on dogs with CAD.

1.7.2.5. Topical glucocorticoids

Topical glucocorticoids can be used in chronic CAD to treat new flare ups. The treatment usually continues until the symptoms have completely diminished. Prolonged use of topical glucocorticoids increases risk of skin atrophy therefore should be used with caution and with regular control visits with the veterinarian. To reduce the adverse effects of the long-term use the application frequency can be reduced (Saridomichelakis and Olivry, 2016; Bruet et al., 2022).

1.7.2.6. Oral glucocorticoids, ciclosporin and oclacitinib

Oral glucocorticoids, ciclosporin and oclacitinib can be used to treat chronic CAD if there is flare up of symptoms. Oral glucocorticoids and oclacitinib act faster than ciclosporin but they are all very effective treatment options. Ciclosporin can be paired with oral prednisolone for the first three weeks to improve the relief of clinical symptoms (Dip et al., 2013; Olivry et al., 2015). Ciclosporin acts as a calcineurin inhibitor resulting in decrease of the synthesis of cytokines (Steffan et al., 2006).

The adverse effects of long-term use of ciclosporin includes vomiting, diarrhea, and nausea. These adverse effects usually only occur during the initiation phase of the treatment and then resolve (Steffan et al., 2006; Dip et al., 2013; Saridomichelakis and Olivry, 2016). Some not so common side effect of ciclosporin is aggression, weight loss, anorexia, cutaneous papillomatosis, gingival hyperplasia, urinary tract infections, neurological issues, hypertrichosis and in rare cases opportunistic infections. During ciclosporin treatment administration of live vaccines should be avoided (Nuttall et al., 2014; Bruet et al., 2022). Ciclosporin may interact with some medications as phenobarbital, antifungals, metoclopramide, erythromycin, clindamycin, and cimetidine. Also, vitamin E supplement or grapefruit juice may cause and interaction with ciclosporin (Forsythe and Paterson, 2014).

If glucocorticoids are used long-term, the dog should be monitored with physical examination, complete blood count, biochemistry, urinalyses, and urine cultures due to increased risk of urinary tract infections (Olivry et al., 2015).

Oclacitinib can be used for long-term since it is well tolerated and adverse effects of long-term use are proven to be minimal (Bruet et al., 2022).

1.7.2.7. Recombinant interferons

Recombinant interferons can be an effective treatment option for CAD. They are proteins that has an anti-tumor, anti-viral and immunomodulatory effects on the body. Studies has shown a possible effect being balancing cytokine levels of Th1 and Th2 which can be an imbalance with a dog suffering from atopic dermatitis. Interferons are divided into two groups, type 1and type

2. Adverse effect of interferon treatment can be an increased pruritus (Iwasaki and Hasegawa, 2006; Carlotti et al., 2009).

1.7.3. Preventing recurrent symptoms of canine atopic dermatitis

1.7.3.1. Avoiding factors causing symptoms

Olivry et al. (2015) suggested the most effective way to prevent new flare ups of symptoms being recognizing and avoiding the known flare factors, such as maintaining good hygiene in the household, storing the food properly, giving proper good quality food and treating the dog regularly against ectoparasites.

1.7.3.2. Lokivetmab (Cytopoint)

Lokivetmab commonly known as Cytopoint with its trade name is a monoclonal antibody that blocks the effect of canine interleukin-31 which is a cytokine causing pruritus in dogs. Interleukin-31 signals many pathways as Janus kinase and protein kinase pathways causing changes in cells as immune cell chemotaxis, and pro-inflammatory cytokine and chemokine secretion. These changes cause alterations in cell differentiation, proliferation and barrier protein synthesis leading to pruritic responses of the skin and skin barrier disruption. (Fleck et al., 2021; Krautman et al., 2023). Lokivetmab is well tolerated and has minimal side effects, hypersensitivity reactions to the injection are very rare, some dogs may develop diarrhea, vomiting, lethargy, anorexia, otitis externa, dermatitis, pyoderma, erythema, and pruritus. Very rare side effects include immune-mediated hemolytic anemia or immune-mediated thrombocytopenia, neurological signs and injection site pain or swelling (Bruet et al., 2022; Krautman et al., 2023). Lokivetmab has a quick onset of action (4 to 24 hours) therefore very suitable also to treat flare-ups. Injections are usually administered once a month, needing regular veterinary visits which may increase the caregiver burden of owners. Lokivetmab seems to be safe to use in dogs with liver, renal, urinary, and neoplastic diseases as well as with diabetes mellitus (Bruet et al., 2022).

1.7.3.3. Allergen-specific immunotherapy

Allergen-specific immunotherapy is proven to be an effective option to treat canine atopic dermatitis. However, the remission of clinical sign can take months, therefore other quick acting treatment should be used simultaneously until the immunotherapy is showing and effect. Immunotherapy should be continued for at least a year to evaluate its efficacy (Olivry et al., 2015; Mueller, 2019).

Allergen specific immunotherapy aims to stop the pathogenic mechanism causing the disease. In this therapy the patient is injected with allergens that triggers the immune response which activates immunosuppressive cytokines and regulatory T cells. The specific triggering allergens that will be used in the immunotherapy can be tested with either intradermal allergy testing or with serum tests, both of which have shown an equal accuracy. The allergen test must be combined with the clinical signs since not all allergic reactions during allergy testing are the cause the patients' symptoms (Plant and Neradilek, 2016; Mueller, 2019).

The allergen specific immunotherapy is indicated when an anti-inflammatory therapy is not working, or the treatment is difficult to maintain over longer periods of time or the treatment has too harmful side effects. The efficacy of the immunotherapy can be affected by different factors. These can be the age when the dog was diagnosed with CAD, how severe the clinical signs are, how many reactions and at what strength the intradermal test reaction has caused, how quickly the dog was presented to the immunotherapy and which type of allergen is causing the hypersensitivity reactions (Griffin and Hillier, 2001). However, in two studies conducted by Zur et al. (2002) and Fennis et al. (2022) they did not find a statistically significant difference of the treatment outcomes compared to breed, age, sex, time of diagnosis, seasonality of clinical signs, and time between having symptoms and start of immunotherapy.

The adverse effects caused by the immunotherapy are uncommon. Most common adverse effect seen in atopic dogs is increased pruritus after the injection. Other possible adverse effects can be vomiting, diarrhea, depression, anxiety, angioedema, panting and anaphylaxis. Cutaneous adverse effects include local edema, pruritus, erythema, and pain (Griffin and Hillier, 2001; Mueller, 2019).

There are many different types of immunotherapies that can be used in dogs with atopic dermatitis. These includes subcutaneous allergen, rush, intralymphatic, and oro-mucosal immunotherapies. In subcutaneous allergen immunotherapy the allergens are injected subcutaneously, and the concentration and volume of the allergen is then gradually increased during few weeks to few months. After this period a several years long period starts where the same amount of the allergen is injected into the skin every few weeks to once a month continuously. This therapy will be time and financially consuming to the owners since regular veterinary visits are needed. With rush immunotherapy the duration of injection is cut short and instead of giving injections over several weeks to month the injections are given for a one day and allergens are injected every hour. This treatment can only be done in strict monitoring in a clinic, and it may easily cause an anaphylactoid reaction with the reaction being mostly an

increased pruritus. Before starting the allergen injection an antihistamine medication is recommended. Rush immunotherapy is beneficial to the owners because it reduces the clinical visits needed therefore being financially more suitable and less time consuming. Intralymphatic immunotherapy is a good alternative for the previously mentioned therapy types. Smaller amount of allergen is injected monthly into the submandibular or popliteal lymph nodes. Improvement of the symptoms can be seen after three monthly injections; however, most dog will need longer duration of injections. Oro-mucosal immunotherapy has not shown to be as effective as the previous options. In oro-mucosal therapy the allergen is placed in dogs' mouth between gums and lips daily either once or twice a day (Griffin and Hillier, 2001; Mueller and Bettenay, 2001; Mueller, 2019).

1.7.3.4. Non-specific immunotherapy

Olivry et al. (2015) explained that non-specific immunotherapy covers the use of oral probiotics. However, there is not enough evidence currently of its efficacy on the treatment of canine atopic dermatitis.

2. AIMS OF THE STUDY

This study aims to get a better understanding of how willing the owners are to follow the treatment guidelines in the treatment of atopic dermatitis in dogs. The study aims to understand which challenges the owners find to be the most difficult in the treatment of canine atopic dermatitis, how difficult they feel the treatment management being, and if there is a correlation between the education level of the owners, how long the dog has had the disease, if the disease is on balance, whether there is a good communication between the owner and veterinarian or not, how often they visit the vet clinic, and what they feel to be difficult considering the treatment options.

3. MATERIALS AND METHODS

This study is a descriptive study carried out as a survey in the form of a questionnaire.

3.1 Case selection criteria

Dogs with diagnosed atopic dermatitis were included with any breed, age, and sex that were treated by a dermatologist at the small animal hospital of Estonian University of Life Sciences.

3.2. Questionnaire

Dermatologists at the small animal hospital gave the questionnaire to the owners which consisted of ten questions about their dogs' atopic dermatitis focusing on the treatment and treatment challenges, time of diagnosis and owners' education level. The questionnaire was written in Estonian, and owners answered in Estonian. Questionnaires were gathered between December 2022 and April 2023. Quantitative and qualitative research strategies were used; questionnaire included both rating scale questions and open-ended questions. In appendices 5 and 6 is shown the questionnaires given to owners in English and in Estonian. From the questions seen in appendices 5 and 6, question number 6 (If on a balance, how easy was it to get to the treatment balance with your dog?) is removed from the data analysis since owners with dogs not on a treatment balance also gave answers to this question saying it was easy to get the dog on a treatment balance, therefore this question is not reliable.

3.3. Statistical analysis

Excel was used to calculate percentages of the results obtained from the questionnaire and provide charts from the results.

3.4. Declaration of ethical considerations

Owners were asked if they would like to participate to the research and verbally agreed when they were visiting the dermatologists. The questionnaires were handed to the owners by dermatologist by an anonymous manner. The researcher received anonymous answers.

4. RESULTS

Together of 14 owners answered to the questionnaire; 13 dogs were included. With one dog both owners answered to the questionnaire on separate veterinary visits.
Three of the thirteen dogs were French bulldogs (23%), three German shepherds (23%), two Griffons (15%), two West Highland white terriers (15%), one Akita inu (8%), one American cocker spaniel (8%), and one Shiba inu (8%) (figure 1).

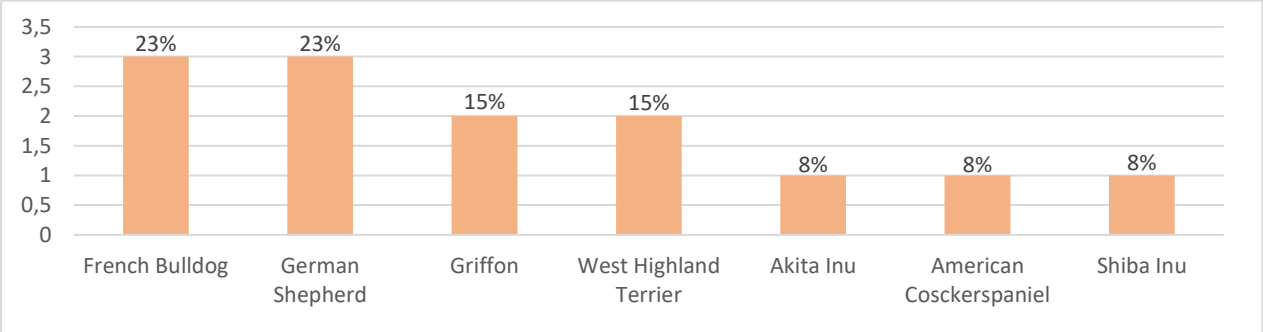

Figure 1. Dog breeds presented

Age of the dogs varied. One dog was a year old (8%), two dogs were 2 years old (15%), three dogs were 3 years old (23%), one dog was 4 years old (8%), one was 5 years old (8%), two were 6 years old (15%), one was 7 years old (8%), one was 9 years old (8%), and one was 12 years old (8%) (Figure 2).

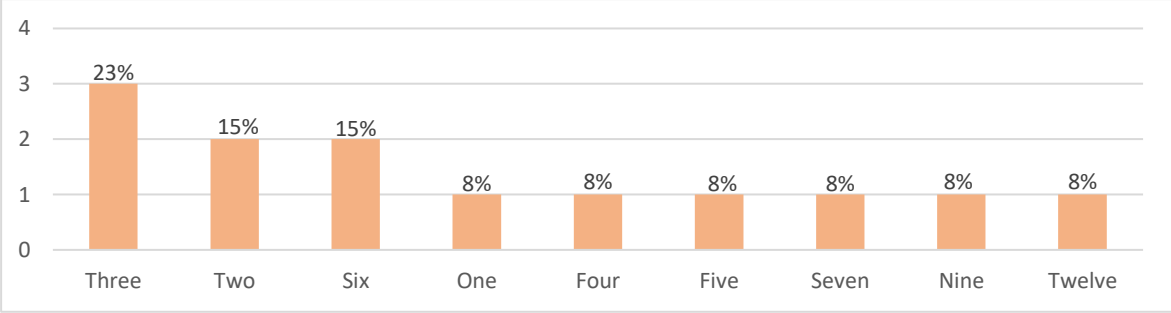

Figure 2. Age of the dogs

Seven of the dogs were females (54%), five dogs were males (38%) and one owner forgot to include the age of the dog (Figure 3).

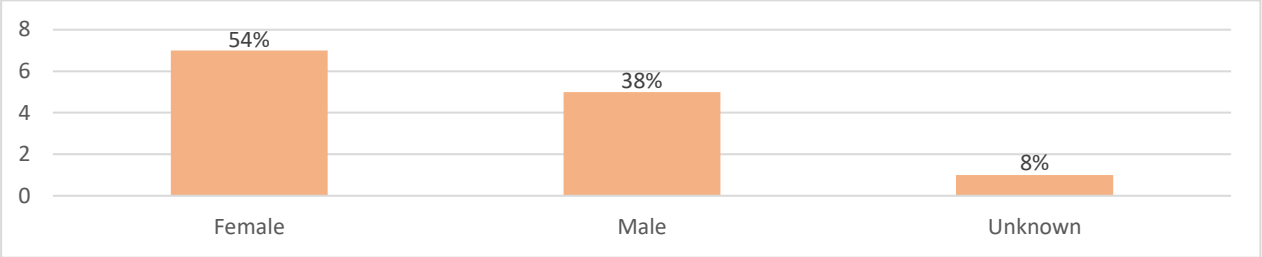

Figure 3. Sex of the dogs

Six dogs were diagnosed with atopic dermatitis when they were one year old (46%), and three dogs were diagnosed at the age of 2 (23%). There was one dog on each age groups diagnosed at three years old (8%), four years old (8%), five years old (8%) and seven years old (8%) (Figure 4).

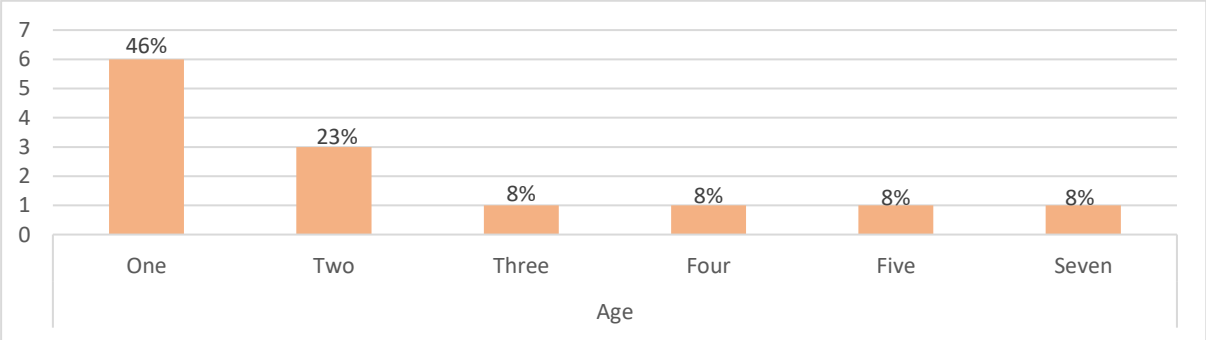

Figure 4. Age of diagnosis of canine atopic dermatitis

Owners described together of 17 treatment options, including allergen specific immunotherapy, oclacitinib (Apoquel), lokivetmab (Cytopoint), ciclosporin, prednisolone, topical hydrocortisone aceponate (Cortavance), and specific diet. Four dogs were treated with oclacitinib (24%). Three dogs were treated with allergen specific immunotherapy (18%) and three with lokivetmab (Cytopoint) (18%). Two dogs were treated with hydrocortisone aceponate spray (Cortavance) (12%) and two dogs with specific diet (12%). Only one dog was treated with ciclosporin (6%). Since the specific diet is important in the treatment of atopic dermatitis, there is probably more dogs on the questionnaire on a specific diet, but owners may not recognize this as a treatment, they may focus more on the medical treatment when writing their answers (Figure 5).

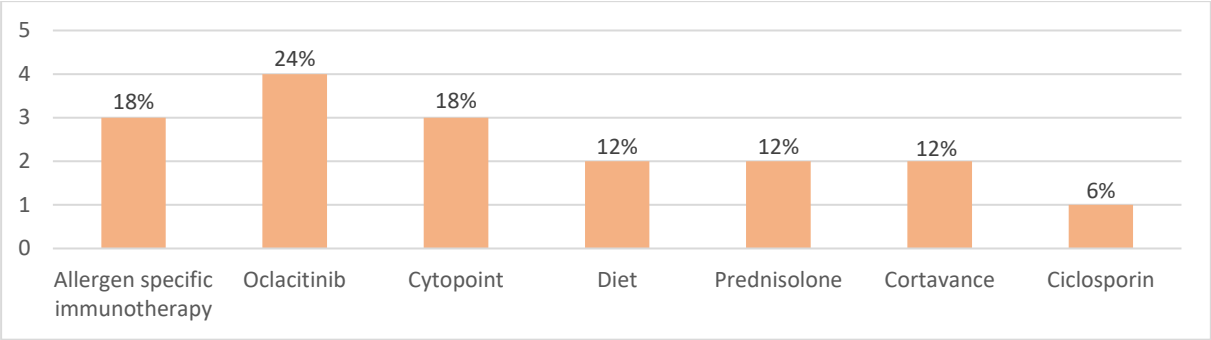

Figure 5. Treatment of the dogs

Five of the owners brought their dogs to the clinic for checkup once a month (38%), mostly these dogs received either lokivetmab injections or allergen specific immunotherapy which needed to be given regularly. Three dogs visited the clinic every six months (23%). Two dogs were brought to clinic once a year or 3-5 times a year (15% each) and one dog every 2 months (8%) (Figure 6).

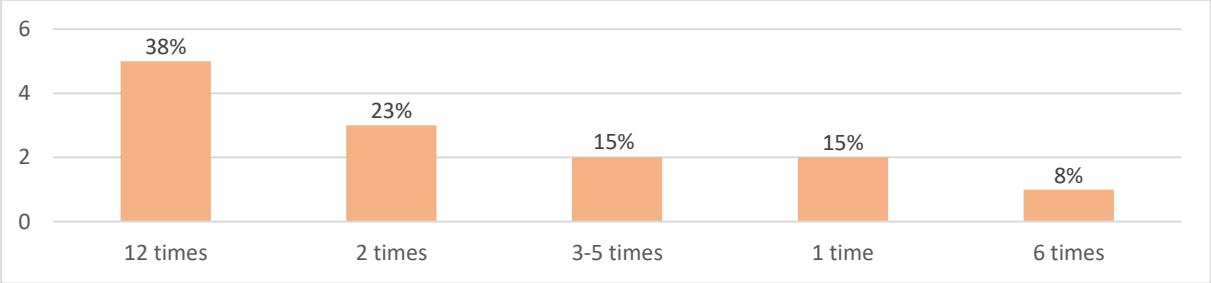

Figure 6. How many times a year the dogs visit the clinic

It can be difficult to get the dog on a treatment balance where there are no or very minimal symptoms of atopic dermatitis. Ten dogs were not on the treatment balance when the questionnaires were given (77%). Three dogs were able to get on the treatment balance (23%) (Figure 7).

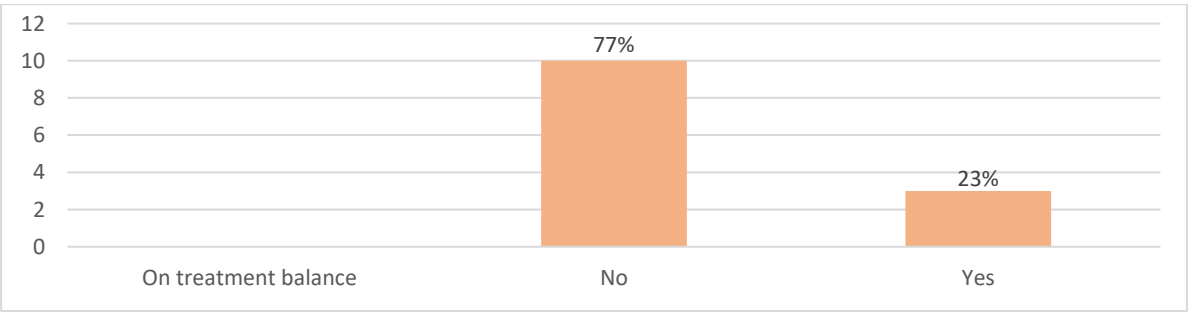

Figure 7. Treatment balance of the dogs

Owners were asked how difficult they feel the management of the treatment of their dogs is. Options were not difficult, moderately difficult, and difficult. Thirteen owners answered that it was not difficult to them to manage the treatment (93%). One owner answered managing the treatment being moderately difficult (7%). No one considered managing the treatment being difficult (Figure 8).

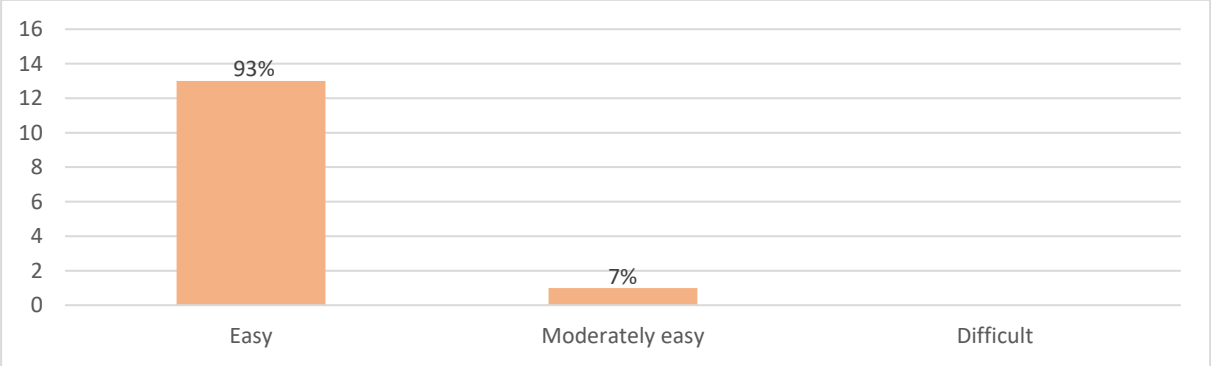

Figure 8. How difficult the owners rate managing the treatment of their dogs being

Owners were asked to choose from the options or write with their own words on what they find to be the most difficult on the treatment of their dogs' atopic dermatitis. Options were treatment costs, regular veterinary visits, administration of the treatment, and side effects of the treatments. Seven owners chose the treatment costs being the difficult aspect (39%). Four owners found the regular veterinary visits challenging (22%). Four owners found administering the treatments being challenging (22%). Two owners felt the side effects of the treatment being difficult (11%). One owner wrote with their own words that challenging aspect is needing two separate veterinarians since dermatologist only treats the dermatological problems but for other treatments, vaccinations, etc. a family vet is needed (6%) (Figure 9).

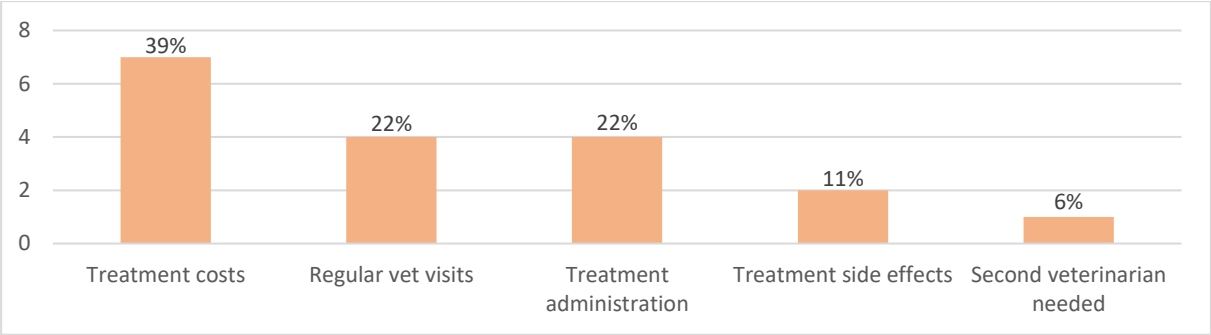

Figure 9. Treatment challenges for the owners

When asked how good they feel the connection with their veterinarian is, with answer options being good, moderately difficult, and difficult, all the owners answered it being good except one owner who forgot to answer to this question.

Last question was the education of the owners. Asking this the researcher wanted to find out if there is correlation between education degree and what they feel being difficult in the treatment, how often they agree to visit the veterinarian and what treatment options they chose. Six owners had a university degree (43%). Four owners had a college degree (29%). Three owners had a secondary education (21%). One owner forgot to answer to this question (Figure 10).

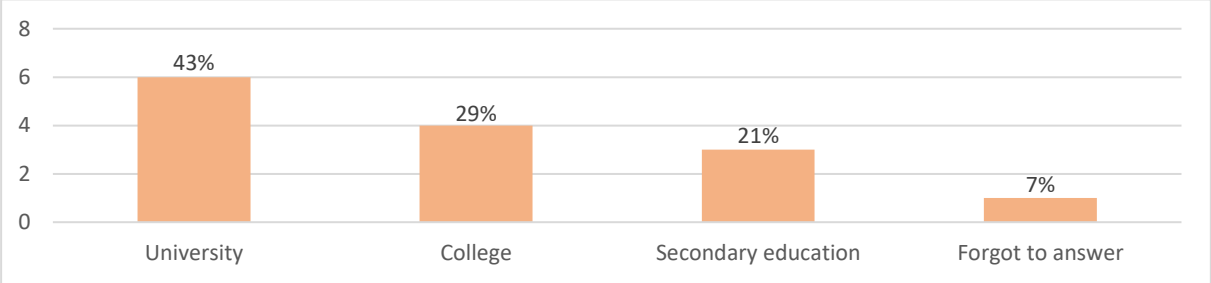

Figure 10. Education of the owners

Three dogs were treated with allergen specific immunotherapy. Two of these dogs visited the clinic once month (67%), and one every six months (33%). One dog was on a treatment balance (33%) and two were not (67%). All the owners found it easy to manage the treatment. Three of the owners found the challenging aspect on the treatment being regular veterinary visits (38%), two owners chose treatment costs (25%), two owners chose treatment administration (25%), and one owner chose treatment adverse effects (13%). Two owners had a university degree (50%) and two had a college degree (50%). All the dogs were diagnosed with CAD within a year (Figure 11).

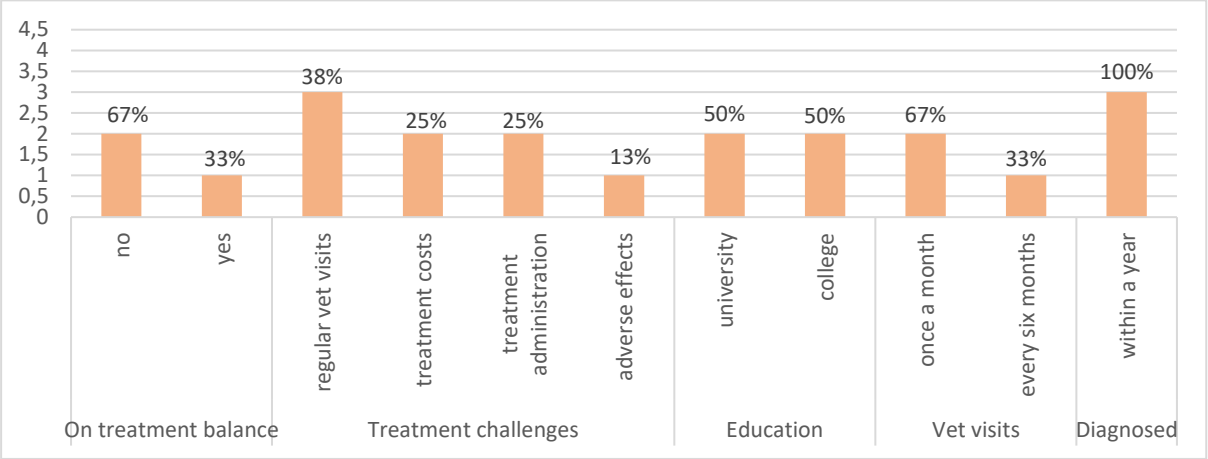

Figure 11. Dogs treated with allergen specific immunotherapy

Four dogs were treated with oclacitinib. All four dogs visited the clinic a different number of times a year. These visits were 4 times year (25%), once a month (25%), every 2 months (25%) and once a year (25%). Three of the dogs were not on a treatment balance (75%) and only one was currently on a balance (25%). One owner found the treatment moderately challenging (25%) and three owners found the treatment easy (75%). Four owners chose the treatment costs being challenging (80%) and one chose regular veterinary visits (20%). Two of the owners had a university degree (50%) one had a college degree (25%), and one had a secondary education (25%) (Figure 12).

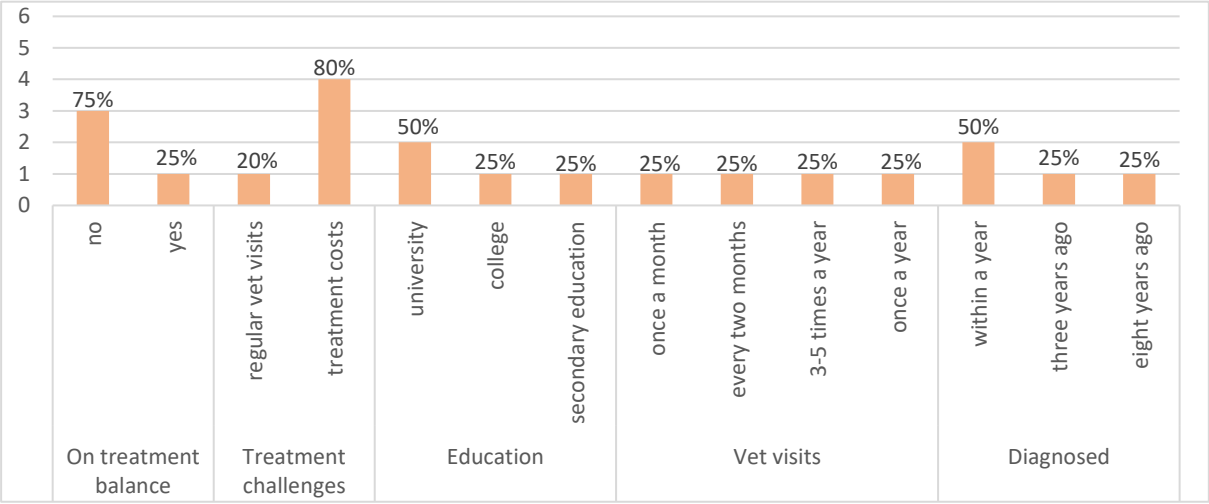

Figure 12. Dogs treated with oclacitinib

Three dogs were treated with lokivetmab injections. Two of the dogs visited the clinic every six months (67%) and one dog visited the clinic once a month (33%). One dog was on a treatment balance (33%) and two dogs were not (67%). All the owners found the treatment management easy. Two owners chose treatment administration being challenging (67%) and one chose treatment costs being challenging (33%). One owner had a university degree (33%), one had a college degree (33%) and one forgot to answer (33%) (Figure 13).

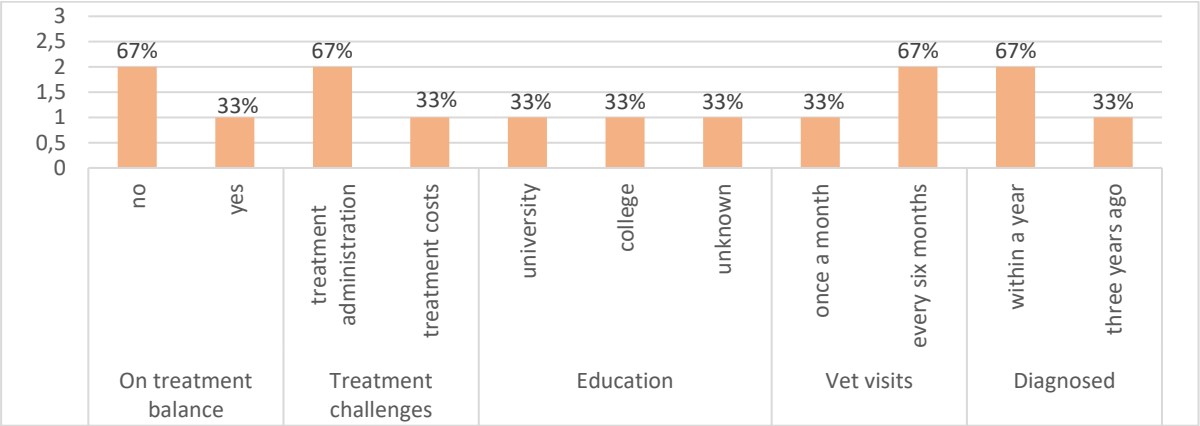

Figure 13. Dogs treated with lokivetmab (Cytopoint)

One dog was treated with ciclosporin. CAD was diagnosed 5 years ago. Dog visited the clinic 4-5 times a year. Dog was not on a treatment balance. The owner found it easy to manage the treatment. The owner chose the treatment administrations being the most challenging in the treatment. The owner had a secondary education.

Two dogs were treated with topical hydrocortisone aceponate. Both dogs were diagnosed 2 years ago. One dog visited the clinic once a year, the other twice a year. Neither of the dogs were on a treatment balance. Both owners found it easy to manage the treatment. One owner mentioned that most difficult in the treatment is having to have another vet to treat the nondermatological issues, the other owner chose the treatment costs and regular veterinary visits being the most challenging in the treatment. Both owners had a university degree.

Six dogs were diagnosed within a year, two treated with allergen specific immunotherapy (33%), one treated with lokivetmab and allergen specific immunotherapy (17%), one treated with lokivetmab injections (17%) and two treated with oclacitinib (33%) (Figure 14). With dogs treated with allergen specific immunotherapy, two owners of the same dog answered to the questionnaire on separate visits, the dog visited the clinic once a month to get the injections, dog is on a treatment balance, other owner found the treatment costs and regular veterinary

visits being challenging and the other chose regular veterinary visits, both owners had a college degree. One owner visited the clinic once a month, dog is not on a treatment balance, owner found the treatment administration and treatment side effects being challenging, and owner has a university degree. One owner visited the clinic currently a second time, with time period of one year, treatment is not yet balanced, owner found treatment administration being challenging, and owner has a university degree. Two owners who chose lokivetmab were both vising clinic once a month, the dogs were on a treatment balance, both found the treatment costs being the most challenging and both owners had a college degree. One owner using oclacitinib visited clinic every two months, treatment is not yet balanced, owner found treatment costs and regular veterinary visits being challenging, and owner has a secondary education. Other owner using oclacitinib visited clinic every three months, dog is on a treatment balance, owner found treatment costs being challenging, and owner has a university degree.

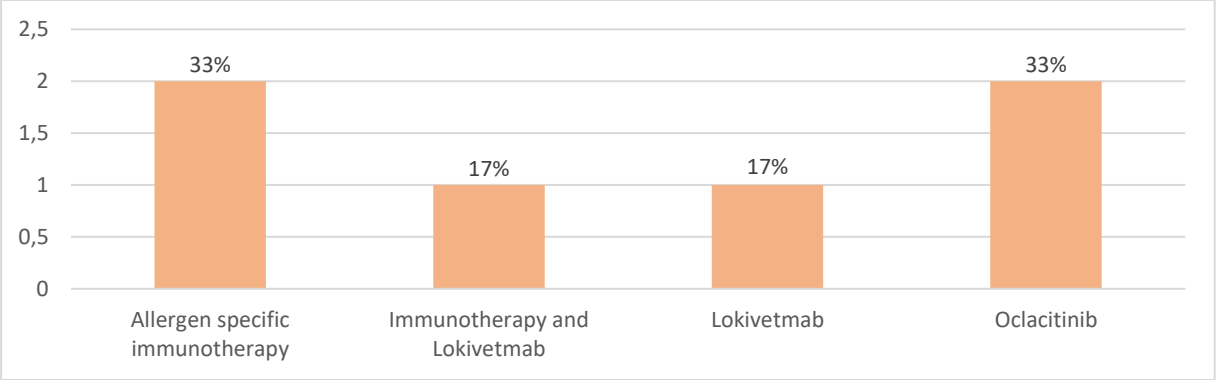

Figure 14. Treatment of dogs diagnosed within a year

5. DISCUSSION

Most presented dog breeds were German shepherds and French bulldogs. No mixed breed dogs were presented.

Most common age of the dogs in the questionnaire was three-year-old. Majority of the dogs were diagnosed at the age of one year old. This shows well the common age for diagnosis being 1- 3 years of age.

Females were the most presented sex in this study.

Gladly none of the owners considered the management of their dogs' treatment being difficult. This could conclude that the caregiver burden is minimal on this study group, however the question was very simple, owners were only asked to rate how difficult they feel the treatment management being and not longer and more specifying questions. It would have been more ideal to include to the questionnaire for example how severe the symptoms of the dog are and ask to specify the symptoms the dog is having and how good the owners rate their emotional and physical wellbeing at home when having an atopic dog.

Oclacitinib, allergen specific immunotherapy and lokivetmab were the most common treatment options. It is positive to see many owners choosing the allergen specific immunotherapy and contributing to maintain the regular allergen injections. In the study was found that all the dogs who were treated with allergen specific immunotherapy were diagnosed recently, within one year. Dogs who have been diagnosed more than a year ago where mostly treated with topical or oral medication, as oclacitinib, ciclosporin or hydrocortisone aceponate. This shows a great improvement on the owners' compliance with the treatment guidelines, the owners having a recent diagnosis for their dogs chose mostly a modern treatment option, either allergen specific immunotherapy or lokivetmab injections and are more willing to visit the clinic more regularly, commonly once a month. Two owners who chose allergen specific immunotherapy were having challenges on the treatment administration to the dog. The reason is not identified, so it is not clear why they feel the challenge, is it the reaction of the dog to the injections (fear of needles, pain, itching etc.) or other reasons.

Understandably the most challenging aspect on the treatment for all the owners were the treatment costs and regular veterinary visits. What makes the treatment of atopic dermatitis expensive is the regular visits with the dermatologist and depending on the treatment options

they are rather costly. Dogs also needs regular blood work done to monitor effects of the medication to the organs.

Most of the dog owners had a higher education, either university or college degree. Allergen specific immunotherapy or lokivetmab injections were only chosen by the owners having a higher education. Owners from all the educations levels commonly agreed the treatment costs being most challenging aspect on the treatment of canine atopic dermatitis.

Finding out all the owners considered the communication between client and veterinarian being good is excellent news since having a good connection and communication with the veterinarian helps understanding their dogs needs and reaching to the best treatment option for each dog when treating the atopic dermatitis.

Since the research group was small with only 14 dog owners answering to the questionnaire the applicability of the results is not so significant. However, the research managed to find correlations between the results and make justifiable conclusions of the owners' opinions on the treatment of canine atopic dermatitis. The research group would have been bigger if the research would have also included dogs suspected having canine atopic dermatitis but not yet diagnosed enough to give a final diagnosis. The treatment for the suspected dogs would have been rather similar but since they still could have had other disease on the background than canine atopic dermatitis it did not feel appropriate to include those dogs on this research. It would have been more ideal to provide the questionnaire in an electrical form since it was difficult on some answers to understand the owners handwriting when asked open-ended questions.

CONCLUSIONS

The most common treatment challenges the dog owners faced when managing their dogs' atopic dermatitis ware the cost of the treatment and need of regular recheck visits with the dermatologist since the treatment is costly and dogs require regular visits to monitor the treatment efficacy and health of the dog. However, owners agreed managing the treatment of their dogs being easy, only one finding it moderately difficult. Majority of the dogs were not on a treatment balance at the time of the study, one dog was managed to get to the treatment balance with allergen specific immunotherapy, one dog with lokivetmab and one dog with oclacitinib. Regardless of the owners having challenges with the expensive treatment and regular veterinary visits, owners were willing to take their dogs to the dermatologist regularly, most dogs visiting the dermatologist once a month. Owners also often chose the expensive treatment option, allergen specific immunotherapy despite having biggest challenges with the cost of the treatment. All the owners who chose allergen specific immunotherapy had the latest diagnosis for their dogs; all these dogs were diagnosed within the last year. This study did not find a correlation with the education level of the owners to the frequency of veterinary visits. There was no correlation with education level and what the owners found to be the most challenging according to the treatment, on all education groups owners found rather equally the treatment costs being the most challenging. A correlation was found with education level and choice of treatment; only owners with higher education chose allergen specific immunotherapy or lokivetmab injections.

ACKNOWLEDGEMENTS

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REFERENCES

Bizikova, P., Pucheu-Haston, C. M., Eisenschenk, M. N., Marsella, R., Nuttall, T., & Santoro, D. (2015). Role of genetics and the environment in the pathogenesis of canine atopic dermatitis. *Veterinary Dermatology*, *26*(2), 95-E26.

Bruet, V., Mosca, M., Briand, A., Bourdeau, P., Pin, D., Cochet-Faivre, N., & Cadiergues, M. C. (2022). Clinical guidelines for the use of antipruritic drugs in the control of the most frequent pruritic skin diseases in dogs. Veterinary Sciences, 9(4), 149.

Carlotti, D. N., Boulet, M., Ducret, J., Machicote, G., Jasmin, P., Rème, C. A., & Albouy, M. (2009). The use of recombinant omega interferon therapy in canine atopic dermatitis: a double-blind controlled study. *Veterinary Dermatology*, *20*(5-6), 405-411.

Cook, C. P., Scott, D. W., Miller Jr, W. H., Kirker, J. E., & Cobb, S. M. (2004). Treatment of canine atopic dermatitis with cetirizine, a second-generation antihistamine: a single-blinded, placebo-Controlled Study. The Canadian Veterinary Journal, 45(5), 414.

Cosgrove, S. B., Cleaver, D. M., King, V. L., Gilmer, A. R., Daniels, A. E., Wren, J. A., & Stegemann, M. R. (2015). Long-term compassionate use of oclacitinib in dogs with atopic and allergic skin disease: safety, efficacy, and quality of life. *Veterinary Dermatology*, *26*(3), 171-E35.

Deboer, D. J., & Griffin, C. E. (2001). The ACVD task force on canine atopic dermatitis (xxi): antihistamine pharmacotherapy. *Veterinary Immunology and Immunopathology*, *81*(3-4), 323-329.

Deboer, D. J., & Hillier, A. (2001). The ACVD task force on canine atopic dermatitis (xv): fundamental concepts in clinical diagnosis. Veterinary Immunology and Immunopathology, 81(3-4), 271-276.

Denti, D., Caldin, M., Ventura, L., & De Lucia, M. (2022). Prolonged twice-daily administration of oclacitinib for the control of canine atopic dermatitis: a retrospective study of 53 client-owned atopic dogs. *Veterinary Dermatology*, *33*(2), 149-E42.

Fennis, E. E., Van Damme, C. M., Schlotter, Y. M., Sinke, J. D., Leistra, M. H., Bartels, R. T., & Broere, F. (2022). Efficacy of subcutaneous allergen immunotherapy in atopic dogs: a retrospective study of 664 cases. Veterinary Dermatology, 33(4), 321-E75.

Fleck, T. J., Norris, L. R., Mahabir, S., Walters, R. R., Martinon, O., Dunham, S. A., & Gonzales, A. J. (2021). Onset and duration of action of lokivetmab in a canine model of Il-31 induced pruritus. Veterinary Dermatology, 32(6), 681-E182.

Forsythe, P., & Paterson, S. (2014). Ciclosporin 10 years on: indications and efficacy. *Veterinary Record*, *174*(S2), 13-21.

Gadeyne, C., Little, P., King, V. L., Edwards, N., Davis, K., & Stegemann, M. R. (2014). Efficacy of oclacitinib (Apoquel®) compared with prednisolone for the control of pruritus and clinical signs associated with allergic dermatitis in client-owned dogs in Australia. Veterinary Dermatology, 25(6), 512-E86.

Gonzales, A. J., Bowman, J. W., Fici, G. J., Zhang, M., Mann, D. W., & Mitton-Fry, M. (2014). Oclacitinib (Apoquel®) Is a novel Janus kinase inhibitor with activity against cytokines involved in allergy. Journal of Veterinary Pharmacology and Therapeutics, 37(4), 317-324.

Gortel, K. (2018). An embarrassment of riches: an update on the symptomatic treatment of canine atopic dermatitis. *The Canadian Veterinary Journal*, *59*(9), 1013.

Griffin, C. E., & Hillier, A. (2001). The ACVD task force on canine atopic dermatitis (xxiv): allergen-specific immunotherapy. *Veterinary Immunology and Immunopathology*, *81*(3-4), 363-383.

Hensel, P., Santoro, D., Favrot, C., Hill, P., & Griffin, C. (2015). Canine atopic dermatitis: detailed guidelines for diagnosis and allergen identification. *Bmc Veterinary Research*, *11*(1), 1-13.

Hill, P. B., & Deboer, D. J. (2001). The ACVD task force on canine atopic dermatitis (iv): environmental allergens. Veterinary Immunology and Immunopathology, 81(3-4), 169-186.

Hillier, A., & Griffin, C. E. (2001). The ACVD task force on canine atopic dermatitis (i): incidence and prevalence. Veterinary Immunology and Immunopathology, 81(3-4), 147-151.

Iwasaki, T., & Hasegawa, A. (2006). A randomized comparative clinical trial of recombinant canine interferon-Γ (Kt-100) in atopic dogs using antihistamine as control. Veterinary Dermatology, 17(3), 195-200.

Krautmann, M., Walters, R. R., King, V. L., Esch, K., Mahabir, S. P., Gonzales, A., ... & Martinon, O. M. (2023). Laboratory safety evaluation of lokivetmab, a canine anti-Interleukin-31 monoclonal antibody, in dogs. Veterinary Immunology and Immunopathology, 258, 110574.

Mueller, R. S., & Bettenay, S. V. (2001). Evaluation of the safety of an abbreviated course of injections of allergen extracts (rush immunotherapy) for the treatment of dogs with atopic dermatitis. American Journal of Veterinary Research, 62(3), 307-310.

Mueller, R. S. (2019). Update on allergen immunotherapy. *Veterinary Clinics: Small Animal Practice*, *49*(1), 1-7.

Noli, C., Minafò, G., & Galzerano, M. (2011a). Quality of life of dogs with skin diseases and their owners. Part 1: development and validation of a questionnaire. Veterinary Dermatology, 22(4), 335-343

Noli, C., Colombo, S., Cornegliani, L., Ghibaudo, G., Persico, P., Vercelli, A., & Galzerano, M. (2011b). Quality of life of dogs with skin disease and of their owners. Part 2: administration of a questionnaire in various skin diseases and correlation to efficacy of therapy. Veterinary Dermatology, 22(4), 344-351.

Nuttall, T., Mueller, R., Bensignor, E., Verde, M., Noli, C., Schmidt, V., & Rème, C. (2009). Efficacy of a 0.0584% hydrocortisone aceponate spray in the management of canine atopic dermatitis: a randomised, double blind, placebo-controlled trial. Veterinary Dermatology, 20(3), 191-198.

Nuttall, T., Uri, M., & Halliwell, R. (2013). Canine atopic dermatitis–What have we learned? *Veterinary Record*, *172*(8), 201-207.

Nuttall, T., Reece, D., & Roberts, E. (2014). Life-long diseases need life-long treatment: long-term safety of ciclosporin in canine atopic dermatitis. *Veterinary Record*, *174*(S2), 3-12.

Olivry, T., & Sousa, C. A. (2001). The ACVD task force on canine atopic dermatitis (xx): glucocorticoid pharmacotherapy. Veterinary Immunology and Immunopathology, 81(3-4), 317-322.

Olivry, T., Mueller, R. S., & International Task Force on Canine Atopic Dermatitis. (2003). Evidence-based veterinary dermatology: a systematic review of the pharmacotherapy of canine atopic dermatitis. Veterinary Dermatology, 14(3), 121-146.

Olivry, T., Deboer, D. J., Favrot, C., Jackson, H. A., Mueller, R. S., Nuttall, T., & Prélaud, P. (2015). Treatment of canine atopic dermatitis: 2015 updated guidelines from the International Committee on Allergic Diseases of Animals (ICADA). *Bmc Veterinary Research*, *11*(1), 1-15.

Plant, J. D., & Neradilek, M. B. (2016). Effectiveness of regionally specific immunotherapy for the management of canine atopic dermatitis. Bmc Veterinary Research, 13(1), 1-6.

Popa, I., Pin, D., Remoué, N., Osta, B., Callejon, S., Videmont, E., ... & Haftek, M. (2011). Analysis of epidermal lipids in normal and atopic dogs, before and after administration of an oral omega-6/omega-3 fatty acid feed supplement. A pilot study. Veterinary Research Communications, 35, 501-509.

Popa, I., Remoue, N., Osta, B., Pin, D., Gatto, H., Haftek, M., & Portoukalian, J. (2012). The lipid alterations in the stratum corneum of dogs with atopic dermatitis are alleviated by topical application of a sphingolipid-containing emulsion. Clinical and Experimental Dermatology, 37(6), 665-671.

Santoro, D. (2019). Therapies in canine atopic dermatitis: an update. *Veterinary Clinics: Small Animal Practice*, *49*(1), 9-26.

Saridomichelakis, M. N., & Olivry, T. (2016). An update on the treatment of canine atopic dermatitis. *The Veterinary Journal*, *207*, 29-37.

Spitznagel, M. B., Solc, M., Chapman, K. R., Updegraff, J., Albers, A. L., & Carlson, M. D. (2019). Caregiver burden in the veterinary dermatology client: comparison to healthy controls and relationship to quality of life. Veterinary dermatology, 30(1), 3-e2.

Spitznagel, M. B., Hillier, A., Gober, M., & Carlson, M. D. (2021). Treatment complexity and caregiver burden are linked in owners of dogs with allergic/atopic dermatitis. Veterinary Dermatology, 32(2), 192-E50.

Steffan, J., Favrot, C., & Mueller, R. (2006). A systematic review and meta-analysis of the efficacy and safety of cyclosporin for the treatment of atopic dermatitis in dogs. Veterinary Dermatology, 17(1), 3-16.

Tarpataki, Bigler, Vajdovich, & Vörös. (2008). Comparison between an intradermal skin test and allergen-apecific Ige-Elisa for canine atopic dermatitis. Schweizer Archiv für Tierheilkunde, 150(3), 117-122.

Zur, G., White, S. D., Ihrke, P. J., Kass, P. H., & Toebe, N. (2002). Canine atopic dermatitis: a retrospective study of 169 cases examined at the University of California, Davis, 1992–1998. Part ii. Response to hyposensitization. Veterinary Dermatology, 13(2), 103-111.

APPENDICES

Appendix 1. Questionnaire in English

Questionnaire for owners of dogs with atopic dermatitis

This questionnaire is for the 6th year veterinary students' final thesis

Q1. What is the breed, age, and sex of the dog?

Q2. When was the atopic dermatitis diagnosed?

Q3. What is the current treatment of your dog?

Q4. How often your dog visits the veterinarian?

Q5. Is your dog on a treatment balance right now? (No symptoms)

Q6. If in the treatment balance, how easy was it to get to the balance with your dog?

( ) Easy

( ) Moderately difficult

( ) Difficult

Q7. Do you find it difficult to understand and follow the treatment recommendations for your dog?

( ) Not difficult

( ) Moderately difficult

( ) Difficult

Q8. What you find to be the most difficult about the treatment recommendations? (You can choose multiple boxes)

( ) Administering the medication to the dog

( ) The treatment is too expensive

( ) Regular re-check visits with the veterinarian

( ) Communication with the veterinarian is difficult

( ) Treatment instructions are difficult to understand and follow

( ) Other? What:

Q9. How would you rate how easy it is to communicate with your veterinarian?

( ) Easy

( ) Moderate

( ) Difficult

Q10. If you feel comfortable answering, what is your education level?

( ) Middle school

( ) Highschool

( ) Other secondary decree education

( ) College

( ) University

Appendix 2. Questionnaire in Estonian

Küsimustik atoopilise dermatiidiga koerte omanikele

Käesolev küsimustik on mõeldud 6. kursuse veterinaariatudengitele loppetöö

Q1. Mis on koera tõug, vanus ja sugu?

Q2. Millal diagnoositi atoopiline dermatiit?

Q3. Milline on teie koera praegune ravi?

Q4. Kui tihti teie koer külastab veterinaararsti?

Q5. Kas teie koer on praegu ravi tasakaalus? (Sümptomeid pole)

Q6. Kui tasakaalus, siis kui lihtne oli koeraga tasakaalu saavutada?

( ) Lihtne

( ) Mõõdukalt väljakutsuv

( ) Raske

Q7. Kas teil on raske mõista ja järgida oma koera ravisoovitusi?

( ) Ei ole raske

( ) Mõõdukalt väljakutsuv

( ) Raske

Q8. Mis on teie arvates ravisoovituste puhul kõige raskem? (Saate valida mitu kasti)

( ) Ravimi manustamine koerale

( ) Ravi maksumus

( ) Regulaarsed korduskontrollkäigud veterinaararsti juures

( ) Suhtlemine veterinaararstiga on raske

( ) Ravijuhiseid on raske mõista ja järgida

( ) Muud? Mis:

Q9. Kuidas hindaksite, kui lihtne on oma loomaarstiga suhelda?

( ) Lihtne

( ) Mõõdukas

( ) Raske

Q10. Kui tunnete end vastates mugavalt, siis milline on teie haridustase?

( ) Algkool

( ) Keskkool

( ) Muu teise dekreedi haridus

( ) Kolledž

( ) Ülikool

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