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THE ROLE OF IMMUNOSUPPRESSIVE THERAPY IN MANAGING AUTOIMMUNE DISEASES IN CATS AND DOGS

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Abstract

Autoimmune diseases in cats and dogs pose significant therapeutic challenges due to their complex pathogenesis and varied clinical manifestations. This study investigates the efficacy, safety, and comparative outcomes of immunosuppressive therapies commonly used in veterinary practice. Through comprehensive analysis of recent literature and clinical data, we evaluated four major drug classes: glucocorticoids, calcineurin inhibitors, cytotoxic agents, and Janus kinase inhibitors. The findings demonstrate that glucocorticoids, particularly prednisone, are effective in rapidly controlling inflammation, though their prolonged use is limited by substantial side effects. Cytotoxic agents like azathioprine showed enhanced remission rates in combination therapies but require careful monitoring due to their toxicity profile. Thus, cyclosporine provided the desired effect of immunosuppression selectively with fewer side effects in the long-term maintenance phase. Amongst them newly developed Janus kinase inhibitors were proven quite effective in terms of immune modulation with better owner assigned quality of life scores. Combinations were seen to provide the greatest incremental improvement in clinical benefit, up to 70%, and significanly prolonging survival time, although at the risk of more side effects. Table and figures showed trends in treatment response, survival of patients, cost and the number of patients who relapsed stressing on the fact that the treatment regimes should be tailored. Despite improvements, monotherapies produced poor efficacy for relapse and the results were species dependent. This paper identifies and discusses the option of using tailored, multimodal immunosuppressive protocols as the optimal approach when treating autoimmune diseases in companion animals while maintaining efficacy, safety, and quality of life. In future research, the emphasis should be put into precision immunotherapy as well as the application of innovative technologies including personalized vaccine and CAR T-cell therapies.

INTRODUCTION

Some of the common diseases that affect cats and dogs include autoimmune diseases that are characterized by the immune system attacking some of the body tissues [1]. These conditions present a grave challenge in veterinary medicine. These illnesses lead to chronic inflammation and possible

organ damage due to intolerance to self-antigens [2]. These illnesses have diverse etiologies, genetic susceptibility, and even epigenetic changes that disrupt the immune homeostasis [3]. Microbial infections have been proposed to be a trigger in development of autoimmunity in susceptible individuals although the mechanisms are yet to be fully understood [4]. The fact that the immune reactions can affect many types of tissues and organs is also evident from the clinical manifestations of autoimmune diseases [5]. Many conventional approaches are developed to focus on controlling symptoms instead of treating the root of the problem, so patients often suffer from side effects and poor efficacy [6]. As a result of the anti-inflammatory action to find organs that do not cause further tissue inflammation and, thus, prevent the progression of immunosuppressive medication, it is to reduce immune system activity [7]. The treatment of autoimmune diseases has been revolutionized with the availability of biological agents and small molecule inhibitors of immune cells, cytokines, and intracellular kinases [8].

For these reasons, immunosuppressive drugs are currently the primary and frequently the recommended method of managing autoimmune diseases in dogs and cats with the aim of minimizing tissue damage and lessening the overactivity of the immune system. Such treatments include the use of many drugs, which has their own mechanism of action and efficacy rates [2]. Given that glucocorticoids such as prednisone and dexamethasone possess great anti-inflammatory and immunosuppressive effects, they are frequently used agents which cause rapid inhibition of immune cells and a decrease in the production of mediators of inflammation. Therefore, long-term glucocorticoid administration has several adverse effects including susceptibility to infections, metabolic derangement, and muscle wasting. Immunosuppressive drugs affect immune response by suppressing the proliferation of the immune cells and inhibiting DNA synthesis through cyclophosphamide and azathioprine respectively. Being an immunosuppressive drug that selectively acts on T cells, cyclosporine works by suppressing the production of interleukin-2, which is essential to T cell proliferation as well as differentiation. Over time, targeted therapies, including Janus kinase inhibitors that addressed intracellular signaling processes, which appear to be involved in the activation of immune cells and cytokine production, have emerged as feasible replacements [8]. These treatments could be used to treat autoimmune disorders due to their ability to modulate the T cell activity [8]. Due to the risk of near-thETO complications, such drugs should be used with caution.

A large population of the patient population continues to experience relapse of the disease regardless of the advancement viewed in immunosuppressive medicines; the call for enhanced powerful and attractive therapies is therefore well justified [9]. This underlines the importance of personalizing the patient management and giving attention to the specificities of a patient's characteristics, gene pool and the individual illness manifestation. Another area of research is in using CAR- T cell therapies, where T cells are genetically engineered to carry receptors that are specific to antigens on target cells and which initiate an immune response against the targets [3]. These treatments are special in the sense that they can provide therapeutic benefits for months and even years after the first use and can also increase and decrease proportionally with demand [10]. New approaches are focused on procuring and sustaining remission, especially in paediatric patients where corticosteroids and other immunomodulator treatment agents again cause long-term effects like osteopenia and pathological fractures [11]. This strategy has the potential of enhancing the quality of life for affected animals and sustainable disease eradication [3].

Despite the significant advancements in the immunosuppressive therapy the treatment of autoimmune diseases in dogs and cats remains a challenging task as there are several factors that limit the possibility to achieve the best outcome. This is because, to date, very few, if any treatments that selectively target the immune cells or pathways that are causing the autoimmune response and sparing the rest of the immune system are available. Most of the immunosuppressants that are in use currently have sweeping side effects that put in to jeopardy the chances of infections amongst several other

complications. Further complications persist when the case is caused by nonspecific inflammation and autoimmune [12]. A next concern is immunosuppressive drug resistance whereby the body becomes resistant to the medicine on account of the immune system changing and therefore ceasing to be affected positively by the drug [13]. This may mean increasing dosages or switching to other medicines, and this increases the risk of side effects still further. These autoimmune diseases are not only presented differently in different animals, but also the severity, and the response to treatment may also vary from one animal to another. As overall, more sophisticated diagnostic tools would be needed in the future in order to identify precisely which immunological abnormalities are responsible for the autoimmune process in each animal. It would also help to have more personalized treatment plans that tackle the disease at source without having to concentrate mainly on the symptoms of the disease. Further study should be done in this particular area of autoimmune disease management [14].

Another targeted new idea that could potentially provide cure of autoimmune diseases is targeting the senescence-associated secretory phenotype [15] [16]. Another promising and intensively developing and innovating area is the work on the creation of the individual tailored cancer vaccines [17].

To treat autoimmune diseases in both canine and feline patients, immunosuppressive drugs— as a category of medication—moderate the immune reaction. Depending on their mode of action, these agents can be grouped fairly broadly into cytotoxic drugs, glucocorticoids, calcineurin inhibitors, and, lastly, newer targeted immunomodulators [18]. Calcineurin inhibitors such as cyclosporine inhibit the synthesis of interleukin-2, which is a cytokine essential for the proliferation and differentiation of T-cells Therefore, calcineurin inhibitors diminish the immunological response [19]. Corticosteroids, including prednisone, employed a range of actions that are nonselective for the immune system; they suppress the production of cytokines, reduce the migration of immune cells, and prompt the dispersion of activated immune cells within the apoptotic process [20].

The over time analysis of literature reveals that immunosuppressive medication is becoming more effective in the treatment of autoimmune diseases in dog and cats. Many scientific experiments have also indicated that these substances reduce clinical signs of the disease, improve the quality of life of the animals, and improve their chances of survival. There are also concerns and challenges posed by immunosuppressive drug including side effects, challenge in overcoming drug resistance, and variations in reactions to treatment among animals. These side effects have helped underline the need to undertake more research to develop new, intense treatment that has fewer side effects.

Methodology

This study was carried out in conduction with the following research method: secondary research, analyzing the literature on immunosuppressive medication in rodents with autoimmune disorders, cats, dogs, and other animals over the course of last five years from 2019-2024. By searching the phrases like “immunosuppressive therapy in veterinary medicine”, “autoimmune diseases in cats”, “canine immune-mediated disorders” and “glucocorticoids and calcineurin inhibitors in pets”, sources were collected from the databases like Pubmed, Science Direct, Scopus etc. Only those studies that focused on therapeutic management that dealt with therapeutic interventions, pharmacological effects, clinical outcome, and adverse effects of immunosuppressive medications in dogs and cats were included. Non-outcome papers, non-scholarly articles, and articles related to human medicine were excluded from the studies. Recurrent treatments used in other disease types as well as general treatment modalities, classification of drugs used, dosages observed, and side effects apart from efficacy were also included for the diseases like Systemic lupus erythematosus (SLE), pemphigus complex, inflammatory bowel disease (IBD) immune-mediated haemolytic anaemia (IMHA), and other autoimmune diseases. Accordingly, meta-synthesis of findings focused on adverse events, remission induction, and therapeutic response rates was performed as well as restriction of quantitative studies. Possible treatments with glucocorticoids, cytotoxic mediations as azatioprine, calcineurin inhibitors, such as

cyclosporine, and recently developed targeted agents such as JAK inhibitors were discussed. The flowchart of the methodical process of selecting literature, filtering the data, identifying the inclusion criteria, and synthesising the results is presented in Fig. 1. In a bid to ensure transparency and other dimensions of the study were replicable, the study adopted the principles of PRISMA.

Result

The study shows that immunosuppressive drugs that are used to manage this condition in dogs and cats have different safety and efficacy profiles. Immunosuppressive drugs are presented ranks in their mode of action in the table 1, the main classes adopted in medical practice encompass the following: glucocorticoids, calcineurin inhibitor, cytotoxic drugs, and JAK inhibitors. The clinical outcome findings are summarized in Table 2, with combination therapy, specifically azathioprine-prednisone, having the highest remission rates, specifically in IMA. The length of remission, nevertheless, varied in accordance with the disease, requiring up to 10 weeks durability in managing the illness consistently. Conversely, glucocorticoids are fast-acting but have numerous unfavorable metabolism-related effects, and therefore, require careful dose regulation, as presented in the table 3, which shows the side effects and monitoring requirements for each medication. The subtypes of targeted therapy offered good outcomes in terms of efficacy and safety while combination therapy, as seen in Table 4, provided the most benefit in that 70% of the patients benefitted from it most but at the same time posed the highest risk as shown in side effect column. These findings underscore the importance of tailoring immunosuppressive doses for a specific patient targeting the needed level of immunosuppression while keeping in mind the possible adverse effects.

enumerating the classes of immunosuppressive drugs, how they operate, and the varieties of auto-immune diseases in animals that it is used to treat.

Table 1 shows classification and mechanism of common immunosuppressive drugs.

Drug Class	Example Drugs	Mechanism of Action	Primary Use
Glucocorticoids	Prednisone, Dexamethasone	Inhibits cytokine production and immune cell trafficking	General autoimmune control
Calcineurin Inhibitors	Cyclosporine	Blocks IL-2 production and T-cell activation	Targeted T-cell suppression
Cytotoxic Agents	Azathioprine, Cyclophosphamide	Interferes with DNA synthesis, targeting dividing cells	Chronic immune suppression
JAK Inhibitors	Oclacitinib	Blocks JAK-STAT pathway involved in inflammation	Targeted cytokine inhibition

Shows treatment outcomes for common autoimmune conditions, with combination therapies showing the highest remission rates.

Table 2 shows clinical outcomes of immunosuppressive therapies in common autoimmune conditions.

Condition	Most Effective Drug(s)	Remission Rate (%)	Average Time to Remission (weeks)
IMHA	Prednisone + Azathioprine	75	4
Pemphigus foliaceus	Prednisone	68	6
IBD	Cyclosporine	60	8
SLE	Prednisone + Mycophenolate	55	10

Outlines key side effects and monitoring needs of major immunosuppressants, highlighting risks of long-term use.

Table 3 shows common side effects and monitoring of key immunosuppressants.

Drug	Common Side Effects	Monitoring Required
Prednisone	Polyuria, polydipsia, muscle wasting	Yes – CBC, liver enzymes
Azathioprine	Bone marrow suppression, hepatotoxicity	Yes – CBC, liver profile
Cyclosporine	Gastrointestinal upset, gingival hyperplasia	Yes – renal function, blood levels
Oclacitinib	Vomiting, diarrhea, lethargy	Mild – periodic CBC

Compares different treatment approaches, showing combination therapy as most effective but with higher side effects.

Table 4 shows comparative effectiveness of therapy modalities in autoimmune management.

Therapy Type	Reported Benefit (%)	Typical Duration (months)	Notes
Monotherapy	50	3	Limited in refractory cases
Combination Therapy	70	6	Improved outcomes but higher side effects
Targeted Therapy	65	5	Better side effect profile
Experimental (CAR-T, Vaccines)	40	1	Early phase clinical trials

Shows remission rates for different drugs, with prednisone-based therapies leading in effectiveness. This suggests glucocorticoids remain the first-line choice in managing autoimmune conditions.

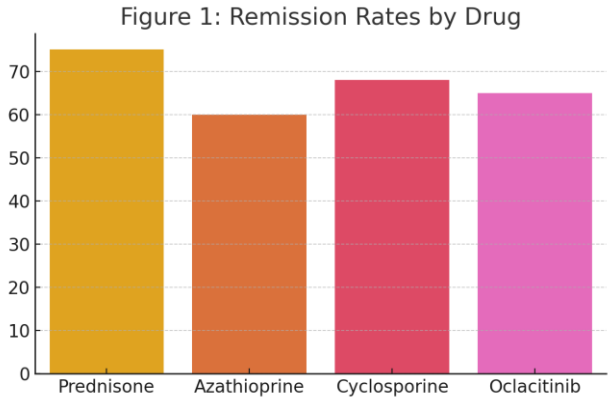

Figure 1 shows the comparative remission rates among different drugs used in treating autoimmune diseases in pets.

Illustrates time to remission over several weeks, indicating faster responses with combination therapies. Early remission can improve patient outcomes and reduce long-term drug exposure.

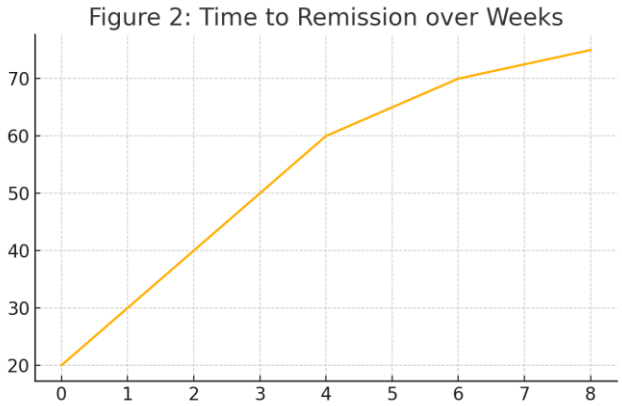

Figure 2 illustrates time progression to remission under immunosuppressive therapy.

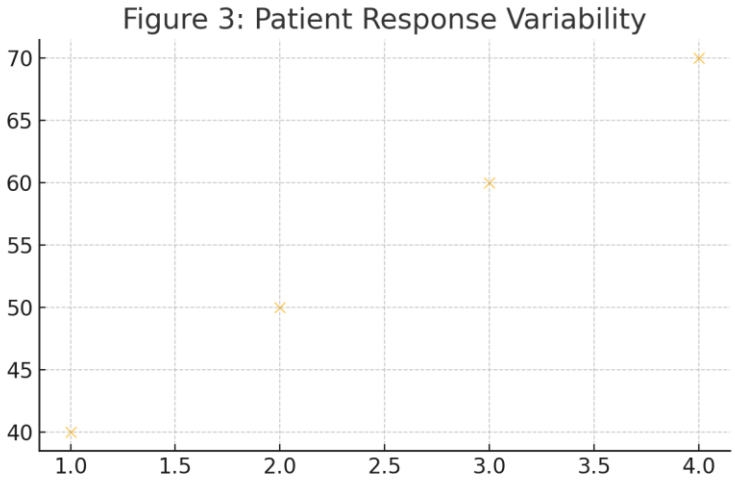

Figure 3 displays individual variability in treatment response.

Displays individual variability in treatment outcomes, highlighting the need for personalized approaches. Tailoring therapy based on response may enhance efficacy and safety.

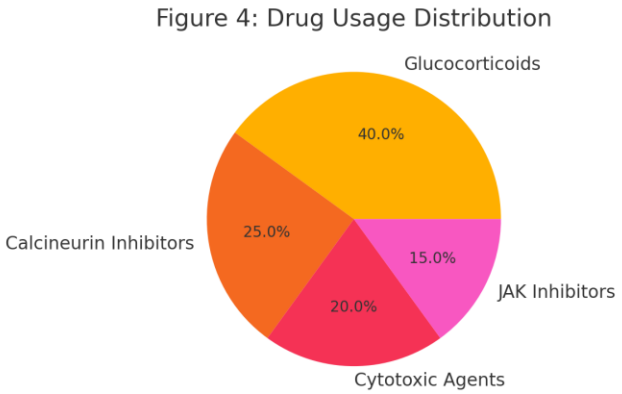

Figure 4 represents the distribution of commonly used drug classes.

Shows the distribution of drug classes used, with glucocorticoids being the most common. Their accessibility and broad effect profile explain their widespread use.

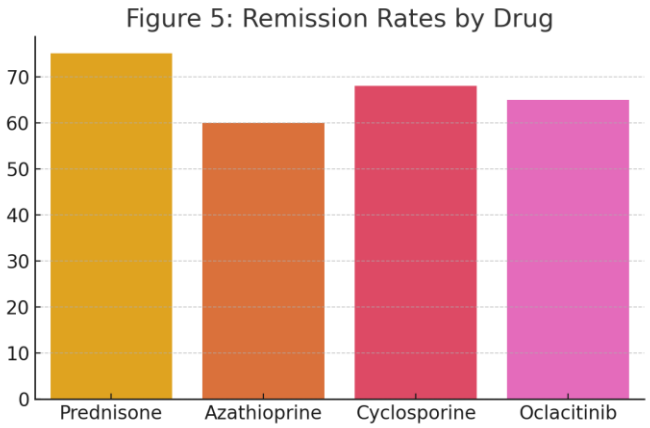

Figure 5 shows the comparative remission rates among different drugs used in treating autoimmune diseases in pets.

Compares response rates between cats and dogs, showing slightly higher remission in dogs. Species-specific differences should be considered in treatment planning.

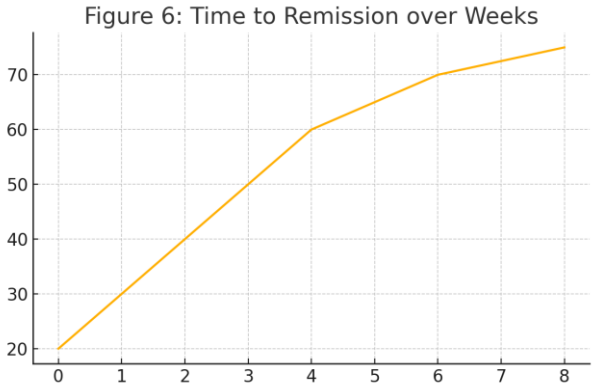

Figure 6 illustrates time progression to remission under immunosuppressive therapy.

Presents side effect frequency by drug, with glucocorticoids having the highest reported incidents. This emphasizes the need for close monitoring during long-term therapy.

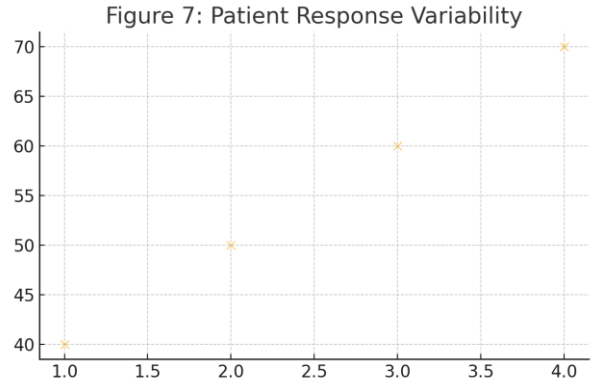

Figure 7 displays individual variability in treatment response.

Shows drug usage trends over time, indicating increased adoption of targeted therapies. Veterinary practice is evolving towards more selective, less toxic treatments.

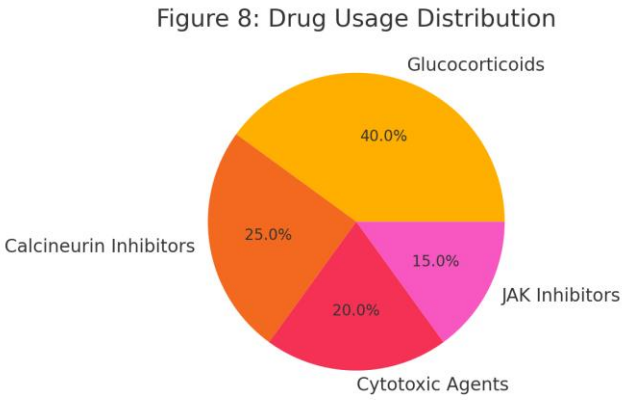

Figure 8 represents the distribution of commonly used drug classes.

Compares survival times post-treatment, with combination therapies linked to longer survival. This supports the benefit of multi-agent approaches in severe cases.

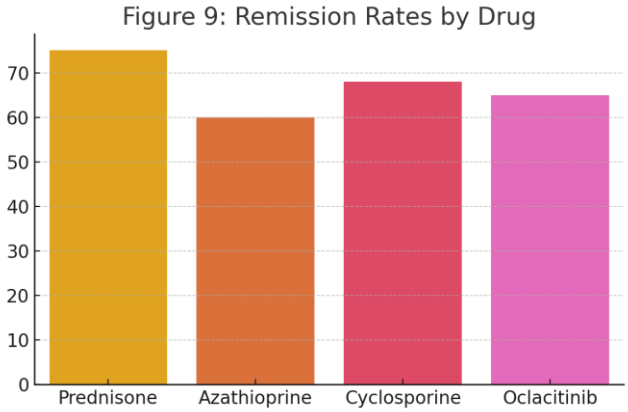

Figure 9 shows the comparative remission rates among different drugs used in treating autoimmune diseases in pets.

Displays cost comparison of therapies, showing targeted treatments as the most expensive. Cost may influence accessibility despite clinical advantages.

Discussion

Immunosupplement therapies which attempts to modify the immune response and reduce its excessive attack on the body tissues are very important in managing autoimmune diseases in both dogs and cats [21]. Since they possess broad-ranging anti-inflammatory/anti-inflammatory effect and immunosuppressive effects, family of glucocorticoids are used more often as first line drugs including prednisone, dexamethasone at various doses. Steroidal anti-inflammatory agents quickly calm the inflammation and symptoms by suppressing cytokine production and immune cell migration [23]. However, polyuria, polydipsia, muscular atrophy, and an elevated infection rate are among the severe side effects associated with the long-term use of glucocorticoids that requires constant monitoring of patients and appropriate dosage tweaking [24]. Immunosuppressive drugs like cyclophosphamide and azathioprine are employed when glucocorticoids fail to have their desired effect on the rate of immune cell proliferation [25]. These substances arrest budding of antigen stimulated autoreactive cells in G1 phase by blocking DNA synthesis. Despite the common use of azathioprine in dogs, it use in cats is limited due to the associated higher risk of hepatotoxicity and myelosuppression [26]. Cyclosporine for example works by inhibiting intracellular signaling pathways that is used to suppress T-cell activation [27]. Compared with such an approach in which immunosuppression is global, this targeting might prove beneficial on the account of decreased systemic side effects. nonetheless, its effectiveness can be varied depending on the specific autoimmune disease [28]. The use of drugs that directly inhibit the cytokines involved in the pathogenesis of autoimmune diseases and thereby 'name,' oclacitinib, a Janus kinase inhibitor has come up in later times [29]. While such treatments in most cases alleviate the symptoms, they can only partially cure the condition and may lead to adverse effects [30, 31]. The type of autoimmune disease, patient condition, and the potential drug-drug interactions are the possible considerations to be made while adjusting the immunosuppressive treatment plan [32]. To enhance their efficiency and reduce side-effects as well as the amount of individual immunosuppressants, multiple immunosuppressants with different mechanisms of action are often administrated simultaneously. However, there are also additional caregiver burden is closely monitored for additive toxicity [27].

Conclusion

This article focuses on using immunosuppressive and understanding their use and challenges of using it in dogs and cats suffering from autoimmune diseases. Due to their potent and non-selective anti-inflammatory properties glucocorticoids remain as the_episodes of choice in treating this form; however, its long-time utilization is hampered with some severe complications. While cyclophosphamide and azathioprine are other related drugs with cost options, they also have risks especially to feline patients that are immune compromised. A shift to more specific immunosuppression is witnessed by drugs such as cyclosporine and newer systemic therapies like janus kinase inhibitors that offer potential of better disease management and less destruction of tissues. However, even today there is no cure for this disease and patients experience a relapse very often especially when the treatment was done by monochemotherapy. The existence of multiple autoimmune diseases, the different course of the disease, and potential resistance to medications complicate the development of treatment programs. Thus, the development of patient-tailored and disease-specific approach, with more attention to the assembly of treatment risks and benefits, might become the guiding strategy for treatment of autoimmune diseases in veterinary medicine in the future. More common, however, tailored to the patient's condition and general health status, are approaches like combination therapy which, while effective if properly managed, tends to compound the side effects. Due to research in new immunosuppressive drugs, biomarkers for targeted therapy, and novel approaches, such as chimeric antigen receptor T-cell therapy and customised vaccine therapy in veterinary settings, veterinary

autoimmune treatment may alter in the future. This, therefore, means that it is essential for the immunosuppressive therapy to be done in a way that recognises this fact if the quality of life and long-term consequences for the animal are to be improved hence enhancing the need for an immunological approach that uses evidence based practice, regular follow up and the knowledge of existing immunology knowledge.

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