

Pemphigus Foliaceus- who, what, when, why and how to treat

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Alice Jeromin, B.S. Pharmacy, DVM, DACVD
Consultant to Heska



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“Pemphigus”...Latin for “blister” Greek for “vesicle”

WHO:

- ▶ The most common autoimmune skin disease in dogs, cats, and horses.
- ▶ Dogs: Chows, Akitas, Labs, GSD, English bulldogs, Cocker spaniels, Dachshund, Doberman, Collies
- ▶ ITP-rare but can be seen in dogs with PF
- ▶ Cats: No breed predisposition
- ▶ Dogs and cats: No sex predilection
- ▶ Most cases seen at end of summer.



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Pemphigus foliaceus (PF): What is it? What causes it?

Desmocollin-1 (DSC-1)

- ▶ Desmosomes “hold together” keratinocytes in the upper layers of the epidermis.
- ▶ Autoantibodies bind to DSC-1 in the desmosomes (not found in mucous membranes).
- ▶ Binding of DSC-1 causes the formerly under tension keratinocytes to “round up” and form ACANTHOLYTIC CELLS.

Acantholytic cells on cytology



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What other diseases can cause the formation of acantholytic cells?

Differential diagnoses:

- ▶ Bacterial pyoderma
- ▶ Fungal-*Trichophyton* spp.-no fluorescence with Wood's light!
- ▶ Leishmaniasis-in areas where endemic

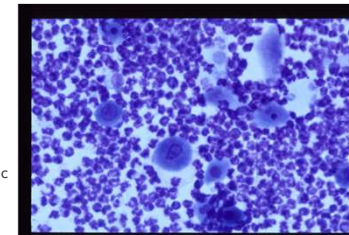


Photo courtesy Dr. Jocelyn Wellington

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Pemphigus-causes of binding to DSC-1?

Most cases are **iatrogenic with no known trigger**, but...

- ▶ **Drugs:** Penicillamine, Penicillin, Cephalosporins, Enalapril, Cimetidine, Doxycycline, Amox/Clav acid, Ampicillin, Sulfas, Itraconazole, Lime sulfur, Vaccines, Allopurinol.
- ▶ Former spot-on's-ProMeris, Vectra 3D, Certifect
- ▶ Human Ketoconazole 2% shampoo in 1 study caused PF in a dog.
- ▶ Drugs can activate proteolytic enzymes in the skin that disrupt desmosomes—acantholysis.

Also:

Foods such as garlic/onions.

Infections can trigger PF in humans.

Paraneoplastic pemphigus: thymoma

UV light

Genetics

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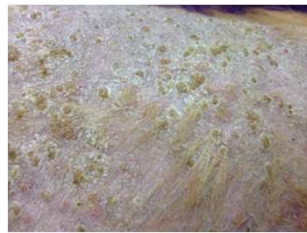
Probable drug-triggered PF in a dog following NexGard administration

- ▶ 9yr old miniature dachshund with chronic pustular dermatitis, fever, weight loss.
- ▶ Occurred within days of administering NexGard, worse with each 5 subsequent doses.
- ▶ Biopsy confirmed PF
- ▶ Treated w/ prednisone and cyclosporine but low doses were required for maintenance.
- ▶ White A, et al. Vet Record (7)2, June, 2019.

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Appearance of PF lesions-crusts, erosions

photos courtesy Dr. Jocelyn Wellington



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Pemphigus foliaceus--DOGS

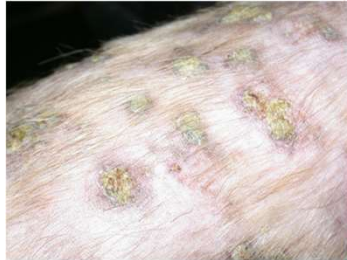
- ▶ Median age of onset: **5 years**
- ▶ Incidence: 3 cases/1000 dogs/year
- ▶ Most lesions first appear **symmetrically on face-dorsal muzzle, concave pinnae.**
- ▶ 66% of dogs will have **generalized** lesions with 35% having **footpad** lesions in addition.
- ▶ **Facial lesions only** in 16% of dogs.
- ▶ If truncal lesions only-need to rule out bacterial pyoderma.



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Pemphigus foliaceus: Dogs-other stuff

- ▶ Fever, lethargy
- ▶ Variable pruritus
- ▶ Mild anemia
- ▶ Leukocytosis
- ▶ Non responsive to antibiotic therapy- especially consider antibiotic therapy in truncal lesions.
- ▶ Breed predisposition and littermate occurrence suggest genetics in dogs.



▶ Photo courtesy of Dr. Jocelyn Wellington

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Pemphigus foliaceus (PF)-diagnosis Be sure to make the diagnosis!

- ▶ **Cytology or biopsy** of crust-subcorneal pustule yields acantholytic cells.
- ▶ Pustules can be transient! If no crusts present-sample the area covering eroded skin.
- ▶ Try and send the pustule and/or crust even if it falls off!
- ▶ Do not prep the skin prior to biopsy.
- ▶ Biopsy off steroids 3 weeks if possible, let pathologist know if/when any former steroid use.
- ▶ **Fungal culture** to rule out *Trichophyton* spp. Special stains like PAS or GMS may be negative if fungal hyphae are not captured in the biopsy.
- ▶ **Complete blood count/serum profile** (you'll need it as a baseline before Rxing immunosuppressant meds).
- ▶ An ANA is NOT necessary in suspected PF.
- ▶ Get a good history of meds, supplements, topicals, vaccines the patient has been taking and for how long prior to emergence of lesions.

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Pemphigus foliaceus-treatment DOGS No "one size fits all"! What I start with:

- ▶ **Oral steroids (not injectable-why?)**
- ▶ Prednisone 1-4mg/kg daily and taper gradually until no new lesions or 80% of existing lesions are "quiet". Extremely variable!
- ▶ Rapid onset of action.
- ▶ Works by suppressing T cell function, inducing apoptosis, and in some patients, inhibits B cell antibody production.
- ▶ Gradually reduce by 25% every 2 weeks.
- ▶ If reduce too quickly, every time you go back to pred, it will work less! (tolerance).
- ▶ If patient no longer responding on one steroid, may have to switch to another.
- ▶ Remember in dogs, steroid-associated gastric ulceration can occur as early as in 14 days with no clinical signs!
- ▶ **Other steroid options:**
- ▶ Methylprednisolone: remember 4mg = 5mg prednisone
- ▶ Dexamethasone 0.1-0.2mg/kg once daily
- ▶ Triamcinolone acetonide 0.2-0.6 mg/kg once daily.
- ▶ Doxycycline 5mg/kg bid with food.
- ▶ Niacinamide 250mg/500mg tid (depends on size of dog)
- ▶ Prescription hypoallergenic diet
- ▶ Sun avoidance
- ▶ Vitamin E 20iu/kg orally once daily

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Why Tetracycline antibiotics and Niacinamide together?

- ▶ Tetracycline (TCN), Doxycycline, Minocycline-all have potential anti-inflammatory properties.
- ▶ Tetracyclines suppress neutrophil chemotaxis, lymphocyte activation.
- ▶ Niacinamide + Tetracyclines together: prevent inflammatory cells from "homing" to site of inflammation.
- ▶ Dose: TCN 250mg tid of each together if dog weighs < 10-25kg or 500mg tid of each together if dog weighs >10-25kg.



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Combine steroid initially with a long term nonsteroidal immunosuppressant

- ▶ **Azathioprine** 1mg/lb. body wt. once daily or every other day (depends on how severe the dog is). Get CBC/profile first.
- ▶ Targets cell mediated immunity, interferes with lymphocyte proliferation.
- ▶ Takes 2-6 weeks to become effective.
- ▶ Watch liver enzymes, leukopenia, thrombocytopenia with Azathioprine and potential for pancreatitis.
- ▶ Check CBC/liver enzymes again in 2-3 weeks then again in a month then q 3-6 months.
- ▶ Recheck 10-14 days after starting steroid/Azathioprine regimen. If improving by 80%, start to reduce steroid, get CBC/profile for Azathioprine.
- ▶ Recheck again in 2 weeks getting another CBC and gradually reducing the steroid.
- ▶ If no improvement in the first 10-14 days, consider changing current steroid (continue Azathioprine) and recheck in 1 week.
- ▶ Once off steroids, can slowly reduce Azathioprine to qod or 2-3x/week.

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What about hepatotoxicity and/or myelosuppression with QOD Azathioprine?

- ▶ 41 client-owned dogs on glucocorticoids and Azathioprine **QOD** for a minimum of 2 months.
- ▶ Dogs were being treated for dermatological conditions.
- ▶ Analyzed data from 1994-2020.
- ▶ Hepatotoxicity defined as 2x ALT.
- ▶ 2/41 dogs had elevated ALT at 18 and 40 days respectively.
- ▶ 1 dog: 1.9mg/kg QOD had 4x ALT rise. Another on 2.3mg/kg QOD had a 30x ALT increase.
- ▶ In this study, Azathioprine was not associated with thrombocytopenia, neutropenia, anemia. Lymphopenia in 1 dog at 105 days.
- ▶ Eberhardy A, et.al. Prevalence of hepatotoxicity and myelosuppression with alternate day use of azathioprine and glucocorticoids for treatment of dermatological conditions in dogs. Vet Derm 2022, 00: 1-8.
- ▶ Hepatotoxicity when used **SID** is dose-dependent and usually occurs in first 30 days.
- ▶ Recommended monitoring for **SID** dosing: before Rx then q 2 weeks x 2 months, then q 2 months.

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Nonsteroidal immunosuppressants-DOGS

- ▶ **Modified Cyclosporine:** 5-10mg/kg once daily (higher doses used in PF than atopy).
- ▶ Can be effective as monotherapy (when you can't use steroids like in diabetes, pancreatitis). Caution in diabetics-can raise glucose levels.
- ▶ Give with food to reduce gi upset.
- ▶ Generic produced higher serum levels than brand name in 1 study.
- ▶ Can reduce to qod or 2-3x/week as patient improves.
- ▶ When used with steroids 9/11 CR in 65 days. 6 dogs went off steroids completely. Chong E, NAVDF Abstract 2022



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Other nonsteroidal immunosuppressants used in PF-DOGS

- ▶ **Mycophenolate** 20-45mg/kg daily divided-in 1 study 16% of dogs went into remission. Most dogs required accompanying steroid doses. Monitor CBC. Inexpensive, diarrhea-within 10 days. Best to start at 10mg/kg and titrate up (avoids diarrhea)
- ▶ **Leflunomide** 2-4mg/kg once daily-monitor similar to Azathioprine
- ▶ **Chlorambucil** 0.1-0.2mg/kg sid-bid Monitor CBC, expensive for large dogs.
- ▶ **Bruton's tyrosine kinase inhibitor (Ritabrutinib)**-15mg/kg once daily-all 9 dogs w/ PF showed reduced lesions. In a 3 dog study, NR in 20 weeks.
- ▶ **Rituximab**-anti-CD20 antibody
- ▶ **Cyclophosphamide** 25mg/m² q 24-48 hours, hemorrhagic cystitis
- ▶ **IV human immunoglobulin** 0.5mg/kg IV over several hours
- ▶ **Polysulfated glycosaminoglycans (Adequan)** 4.4mg/kg SQ 2x/wk. Monitor PT/PTT
- ▶ **Adipose tissue-derived stem cells mesenchymal + steroid CR for one year in 1 dog.**

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Oclacitinib for PF in dogs-JAK1 inhibition maybe helpful in canine PF

- ▶ Oclacitinib 1mg/kg bid, one study of 4 dogs-2 improved by 65% after 1 month, 2 excluded due to neoplasia (fibrosarcoma, skin LSA)
- ▶ Another study: 3/11 cases-no response, 8/11 good response with 5/8 CR. 3/8 required bid dosing. WAVD 10/2020
- ▶ 9 dogs with PF: 0.5mg/kg bid x 14 days. 3/9-no response, 6/9 good response, 5/6 complete resolution (CR). Rapid improvement seen in all the dogs.
- ▶ 2/6 required bid maintenance dosing, rest went to once daily.
- ▶ Burton, Walczak WCVD 2020
- ▶ Pemphigus can accompany atopy and flare with allergy flare ups.
- ▶ Few studies show PF maybe more common in allergic dogs.
- ▶ Possible use as first-line therapy pending biopsy results.



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Oclacitinib compared to Azathioprine in management of canine PF

- ▶ Which Rx had the best steroid-sparing effect and/or use as monotherapy?
- ▶ Oclacitinib 0.4-0.6mg/kg bid x 15 dogs
- ▶ Azathioprine 1-2mg/kg sid x 15 dogs
- ▶ 13/15 AZ-remission
- ▶ 11/15 OC-remission
- ▶ AZ group had 77.7% reduction in original steroid dose.
- ▶ OC group had 69.38% reduction
- ▶ Hernandez-Bures, A. NAVDF 2023 resident abstract

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PF Dog Refractory cases-consider...

- ▶ Hypoallergenic diet
- ▶ UV light exposure
- ▶ Did you fungal culture?
- ▶ Did dog develop dermatophytosis, demodicosis, or bacterial pyoderma as result of the steroid?
- ▶ Change to different steroid, i.e. from pred to dex, pred to triamcinolone acetonide. No long-acting steroid injection!
- ▶ Underlying cancer? i.e. thymoma
- ▶ Combine immunosuppressants
- ▶ Is your diagnosis correct?
- ▶ Did you check cytology/biopsy?



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PF-Dogs Prognosis

- ▶ Prognosis in dogs: Fair-to-Good
- ▶ CR 50% of dogs, time to remission 4-7 weeks.
- ▶ 52% CR, 35% PR, 13% euthanized-treatment failure, treatment side effects, poor quality of life.
- ▶ Survival >10 months=positive long-term outcome.
- ▶ Remember the lesions can wax and wane.



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PF Dogs vs. Cats

Cats

- ▶ Adhesion molecule not known.
- ▶ No age, breed, sex predilection.
- ▶ Face, ears, nailbeds, nipples
- ▶ 97% of cats controlled on prednisolone 2mg/kg/day in 8 weeks.
- ▶ Cats more likely to be controlled on low dose steroid as monotherapy.
- ▶ Prognosis: good

Dogs

- ▶ DSC-1 attacked by autoantibodies
- ▶ Some breeds affected more than others i.e. Akita, Chow.
- ▶ Face, pinnae, trunk, footpads
- ▶ 38% of dogs controlled on prednisone 1.5mg/kg/day as monotherapy.
- ▶ 4/5 dogs CR on pred/cyclosporine
- ▶ Prognosis: fair

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Pemphigus Foliaceus (PF) in cats

Before treatment



After treatment



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Pemphigus foliaceus in cats

WHO:

- ▶ The most common autoimmune skin disease of cats.
- ▶ Incidence 1 case/100 cats/year with skin disease.
- ▶ No breed or sex predisposition, most are DSH or Siamese.
- ▶ Age of onset: 1-17 years, median 7 years of age.
- ▶ Desmosomal target unknown in cats.
- ▶ Photo courtesy Dr. Jocelyn Wellington



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PF in cats: What causes it?

Most cases iatrogenic-no trigger



Reported drug induced cases in cats:

- ▶ Methimazole
- ▶ Cimetidine
- ▶ Ampicillin
- ▶ Itraconazole
- ▶ Lime sulfur
- ▶ Ipadate
- ▶ Vaccination
- ▶ Doxycycline
- ▶ Underlying thymoma in 1 cat and leishmaniasis in 1 cat.

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PF in cats: clinical presentations

- ▶ Pustules, erosions, crusts
- ▶ Symmetrical in 97% of cases
- ▶ Face/head 89%, concave/convex surfaces of ear pinnae 91%, claw folds 74%
- ▶ Common to see **triad of face/head, nailbeds/feet, nipples**.
- ▶ +/- pruritus as blisters emerge
- ▶ Lethargy, fever in >50% of cats with PF



▶ Photo courtesy Dr. Jocelyn Wellington

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PF in cats: differential diagnoses

- ▶ Bacterial pyoderma-cats DO get it!
- ▶ Dermatophytosis: *Trichophyton* spp.
- ▶ Drug eruption
- ▶ Atopy with secondary pyoderma
- ▶ Pemphigus erythematosus
- ▶ Herpes viral dermatitis if lesions only on head/face. →



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PF in cats: diagnosis

- ▶ **Cytology or biopsy** of crust or pustule-acantholytic cells
- ▶ **Fungal culture** of hair and crusts to rule out *Trichophyton* spp.
- ▶ **Complete blood count**
- ▶ History of medications, supplements, vaccines



▶ Photo courtesy Dr. Jocelyn Wellington

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Appearance of PF lesions in cats



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Pemphigus foliaceus: treatment in CATS

- ▶ Oral steroids-no long acting injectables
- ▶ Comparison of High-dose oral prednisolone: 10mg/kg/day x 3 days then reduced dose OR standard prednisolone 2mg/kg/day—both methods had same time to control.
- ▶ High dose has no obvious benefit.
- ▶ Bizikova P, Burrows A. Feline PF: original case series and a comprehensive literature review. BMC Vet Res. 2019 15:22.
- ▶ Steroid options:
 - ▶ Prednisolone 1-2mg/kg/day
 - ▶ Triamcinolone acetonide 0.2mg/kg/day
 - ▶ Dexamethasone 0.1mg/kg/day-tablet or injectable liquid given orally in food.
- ▶ Topicals- steroids: 0.1% mometasone, 0.1% betamethasone, 0.015% triamcinolone spray.
- ▶ Tacrolimus 0.1%

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Sorry! Some nerdy stuff on steroids in cats and how they differ from dogs...

- ▶ One study found cats have fewer dexamethasone receptors in the liver and skin and binding affinity of these receptors is less than in dogs.
- ▶ PredNISON (prodrug) is not well absorbed by feline gi tract and/or converted into the active predNISOLONE.
- ▶ In one study, only 21% of orally administered predNISON appeared in the blood as predNISOLONE.
- ▶ A single 2mg/kg prednisolone dose produced higher plasma prednisolone concentrations than prednisone (4x higher).
- ▶ Cats with a high body condition score had 2x prednisolone concentrations vs. cats with normal body condition.
- ▶ Simpson D, Burton G. Use of prednisolone as monotherapy in the treatment of feline PF: a retrospective study of 37 cats. Vet Derm 24(6) p. 598-e144.

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Cats>Dogs more likely to be controlled on steroid monotherapy long term, but...

- ▶ 24/37 cats Rx prednisolone monotherapy for induction and maintenance CR in 4 weeks.
- ▶ 4/24 were able to discontinue meds
- ▶ 8/24 on weekly dose of 1.2mg/kg with a range of 0.5-3.5mg/kg
- ▶ 13/37 had other drugs added to the steroid to spare steroid dose or treat a relapse.
- ▶ Adverse effects of steroid monotherapy included:
 - ▶ Increased appetite
 - ▶ Weight gain
 - ▶ Diarrhea
 - ▶ Upper respiratory infections
 - ▶ Transient diabetes
- ▶ Simpson DL, Burton GC. Use of prednisolone as monotherapy in the Rx of feline PF: a retrospective study of 37 cats. Vet Derm 2013;24: 598-601.

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When NOT to use steroid for PF

- ▶ In cases of diabetes, renal disease, pancreatitis, heart disease.
- ▶ NOT OPTIONS
- ▶ OPTIONS include:
 - ▶ Modified cyclosporine
 - ▶ Chlorambucil
 - ▶ Oclacitinib (off label)
- ▶ Gold salts no longer available, adverse effects
- ▶ Azathioprine-neutropenia, leukopenia. Not advisable for use in cats. They don't have the enzyme to metabolize it (TMPT).

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Nonsteroidal immunosuppressants: CATS Modified Cyclosporine (Atopica, Modulis)

- ▶ Modified cyclosporine 5-10mg/kg daily.
- ▶ Average time to disease control: 41 days when used as monotherapy.
- ▶ Maintenance doses 0.7-6.7mg/kg daily
- ▶ More effective when used with steroids.
- ▶ Not to be used in outdoor cats or cats eating raw meat.
- ▶ Do not have compounded!



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Nonsteroidal immunosuppressants: CATS Chlorambucil (Leukeran)-refrigerate!

- ▶ Dose: 0.1-0.2mg/kg every 24-48 hours
- ▶ Compounded is much less expensive than brand name (\$27/tab—used to be \$2/tab!!!)
- ▶ Get cbc before, then in 2 wks., then in 4 wks., then in 3 months, then q 6 months.
- ▶ Start at once daily if severe case or every 48 hours. Use along with steroid or as monotherapy. Can reduce to 2x/wk. once in remission.
- ▶ Anorexia, vomiting, bone marrow suppression-adverse effects.



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Study comparing steroid + chlorambucil or steroid + cyclosporine

- ▶ Did not find any difference in time to remission or disease response.
- ▶ But...cyclosporine group could reduce/stop steroids without a relapse while chlorambucil group could not.
- ▶ Irwin KE, et al. Use of modified ciclosporin in the management of feline pemphigus foliaceus : a retrospective analysis. Vet Derm (2020) 23(5): 403-e76.

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Oclacitinib for PF in cats

- ▶ 1mg/kg bid-50% reduction in pruritus and lesions after 7 days.
- ▶ Dose reduced to 0.5mg/kg bid-owner stopped meds after 6 wks. and cat flared. Restarted meds and controlled achieved.
- ▶ Carrasco J, et al. Beneficial effect of oclacitinib in a case of feline PF. Vet Derm 2021 32(3) 299-301.
- ▶ Anecdotal: 1/4th of a 16mg tablet bid. Some nonresponders, some successful per ACVD members.
- ▶ Apparently dose of Oclacitinib needed for immunosuppression is higher than that for its anti-allergy effect.
- ▶ Remember, Oclacitinib for cats is off label use.
- ▶ Banović, F et al. VetDerm 2019;30: 17-e6.

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Successful management of feline PF with pentoxifylline and topical hydrocortisone aceponate (Cortavance).

- ▶ Cat was FIP positive and on an antiviral not approved for veterinary use when developed PF.
- ▶ Rx: pentoxifylline 26.5mg/kg q 12 hours, omega 3,6 fatty acids, and Cortavance (Virbac) spray bid to lesions.
- ▶ CR of lesions in 2 months.
- ▶ Topical steroid discontinued after 6 months. Pentoxifylline continued sid x 4 months then discontinued.
- ▶ Pentoxifylline used in humans with pemphigus vulgaris-inhibits TNF-alpha. Role in feline PF?
- ▶ Hobi S, et. al. Vet Med Sci. 2022;8: 937-944.

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PF-refractory cases in cats-consider...

- ▶ Hypoallergenic diet
- ▶ UV light exposure
- ▶ Development of bacterial pyoderma, dermatophytosis while on therapy.
- ▶ Change to different steroid i.e. prednisolone to dexamethasone
- ▶ Underlying cancer: thymoma
- ▶ Don't use injectable long-acting steroid!
- ▶ The lesions can wax and wane.
- ▶ Is my diagnosis correct?
- ▶ Prognosis in cats: good
- ▶ Majority of cats (90%) achieved disease control in < 1 month.
- ▶ 17% able to go off meds. Most require long term treatment.
- ▶ 10% of cats-death or euthanasia
- ▶ Bizikova P, Burrows A. Feline PF: original case series and a comprehensive literature review. BMC Vet Res. 2019 15:22.

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To sum it up-what do I use? PF in Dogs

- ▶ Get cbc/profile, fungal culture, biopsy or cytology.
- ▶ Prednisone 1mg/lb. or lower (especially in large dogs) daily if severe lesions but I prefer QOD.
- ▶ Start Azathioprine 1mg/lb. sid or qod depending upon severity of disease. Vit E 20iu/kg sid, sun avoidance. Doxycycline 5mg/kg bid/Niacinamide 250-500mg tid if pyoderma present.
- ▶ Recheck in 2 weeks-have owner call in 1 week. CBC/profile at 2 week recheck. Cbc/profile again in 1 month then cbc/profile q 3-6 months.
- ▶ Once lesions are resolving i.e. in 2 weeks then I slowly reduce prednisone dose i.e. if on 20mg sid, go to 15mg sid x 1-2 wks. then 10mg sid x 1-2 wks. and recheck. Continue Azathioprine as when started.
- ▶ Once reduction or discontinuation of prednisone, continue Azathioprine 3 months then reduce to qod or MWF.
- ▶ Hypoallergenic prescription diet.

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To sum it up-what do I use? Cats

- ▶ Prednisolone 1-2mg/lb. once daily.
- ▶ Chlorambucil (compounded)
- ▶ Get CBC, fungal culture, biopsy or cytology of lesions.
- ▶ Sun avoidance.
- ▶ Prescription hypoallergenic diet especially if cat is hard to pill. If hard to pill, consider dexamethasone (longer acting).
- ▶ No DepoMedrol injections-not effective in the long term.
- ▶ On recheck in 2 wks., get CBC.
- ▶ Reduce prednisolone dose i.e. if on 5mg bid, reduce to 1 l/2 tabs sid, continue Chlorambucil dose.
- ▶ If continues to improve after 2 wks. on 7.5mg sid, reduce to 5mg sid, etc. while continuing qod or MWF Chlorambucil.
- ▶ Recheck in another 2 weeks, get CBC and continue to reduce prednisolone.
- ▶ Can use topical Triamcinolone 0.1% to lesions (inexpensive).

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What about vaccinating a PF patient?

- ▶ At this time effect of immunosuppressives on vaccines is unknown.
- ▶ Keep on monthly flea, tick, and heartworm preventative.
- ▶ Discourage raw diet due to risk of bacterial translocation leading to systemic infection.
- ▶ Avoid dog parks, grooming or boarding.
- ▶ No live or modified-live vaccines.
- ▶ Only core vaccines should be considered.
- ▶ Consider administering 1 vaccine at a time, separated by 2 week intervals.
- ▶ Antibody titers where accepted.
- ▶ Waltor SA, 2023.

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Email me with any questions:
ajeromin@purrfectpet.com



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