Dermatophytosis

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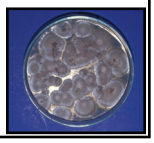
Lecture Plan

- Etiology
- Risk factors
- Pathogenesis
- Clinical signs
- Differential diagnoses
- Diagnosis
- Treatment and monitoring

Etiology

- Superficial zoophilic fungal skin disease of keratinized tissue
- Cats: *Microsporum canis* >> *M. gypseum, M. persicolor*,*Trichophyton* spp.
- Dogs: *M. canis* > *T. mentagrophytes;* rarely *T. erinacei* and *M. persicolor*
- Highly contagious
- Self-limiting
- Low-level zoonosis

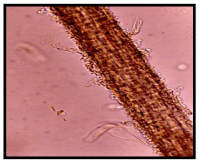


Dermatophytosis – Risk Factors

- Juvenile (< 2 yrs) or geriatric cats
  - Poor body condition
  - Immunodeficient animals
  - Physiological or social stress
- Immunosuppressive therapy
- Factors that limit grooming
- Factors that promote microtrauma
- Yorkshire terrier and Persian cats

Pathogenesis of Infection

- Direct contact with infected animals most important for transmission
- Exposure to infective spores in the environment (soil) or fomites
- Viable spores that contact skin surface need to defeat host protective mechanisms
- Spores begin adhering to skin within 2 hours
- Time from exposure to lesions = 2-4 weeks
- May shed spores BEFORE clinical signs!



Immunity

- Natural infection is rarely recurrent due to effective and long lasting immunity
- Cellular and humoral response is induced
- Th1 cells stimulate cell mediated response (IFN Y, IL-12 and 2) → recovery and protection against reinfection
- Role of humoral response unclear

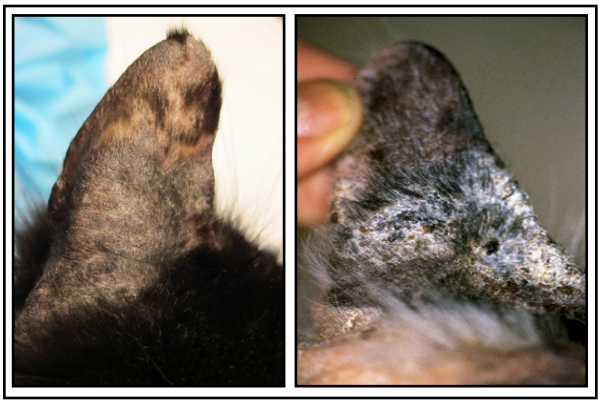
Clinical Signs

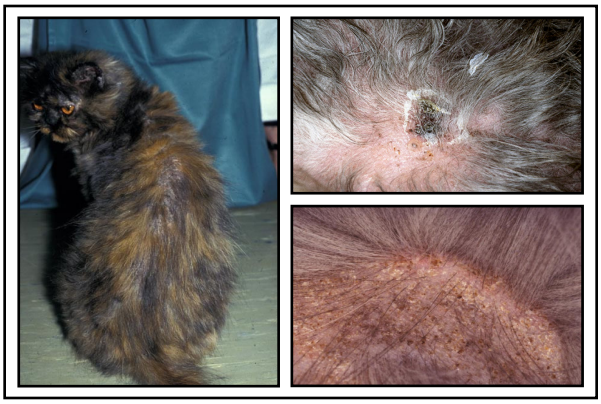
Clinical signs and course of infection determined by:

- Pathogenesis of infection
- Immune response and overall health
- Virulence factors

Clinical Presentations - Cat

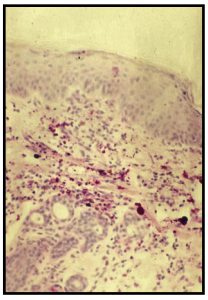
- Asymptomatic carrier
- Focal to multifocal alopecia
- Miliary dermatitis (papulocrustous dermatitis)
- Diffuse alopecia/scale/inflammatory lesions
- Heavy crusts with secondary bacterial infection and pruritus
- Paronychia (uncommon)
- Pseudomycetoma





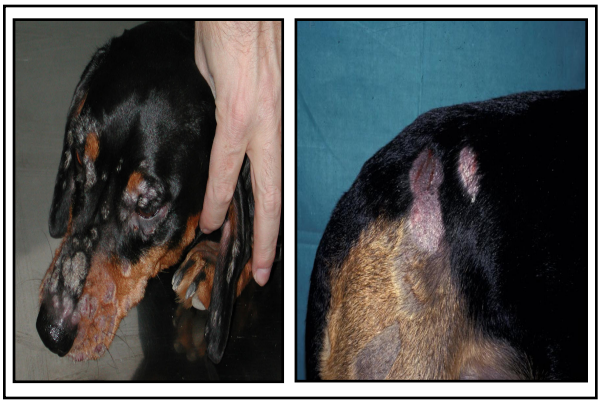
Clinical Presentation: Pseudomycetoma

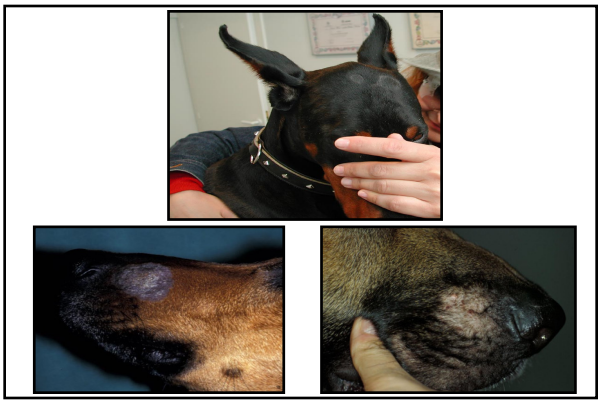
- Usually reported in Persian cats, but also in other breeds
- Granulomatous panniculitis caused by *M. canis*
- Large ulcerated nodules +/- yellow tissue grains

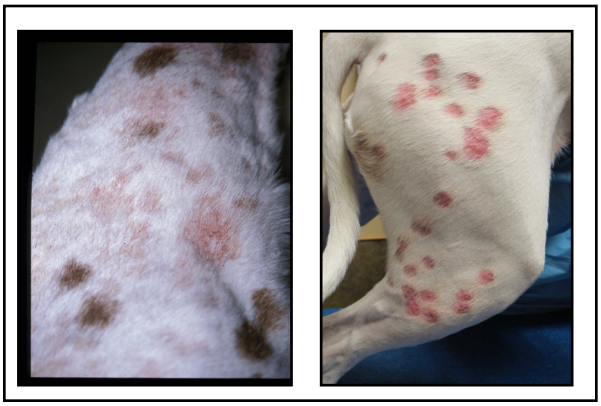


Clinical Presentations - Dog

- Asymptomatic carrier
- Focal to multifocal alopecia
- Diffuse alopecia/scale/inflammatory lesions
- Folliculitis and furunculosis
- Heavy crusts with secondary bacterial infection and pruritus
- Kerion
- Paronychia
- Pseudomycetoma

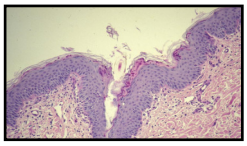






Clinical Presentation: Crusting Dermatosis

- Caused most frequently by *M. persicolor*
- Often on nose or muzzle
- May be clinically and histologically identical to pemphigus foliaceus



Clinical Presentation: Severe Inflammatory Lesions

- Face and limbs
- May mimic immune-mediated disease

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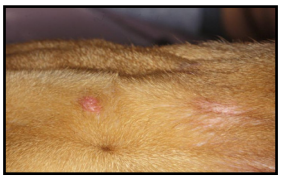
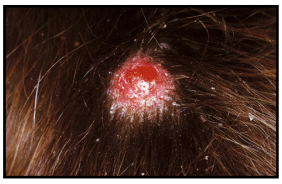
Clinical Presentation: Kerion

- Deep suppurative inflammatory lesions
- Single or multiple nodules
- Often caused by *M. gypseum*
- Resemble histiocytomas





Clinical Presentation: Onychomycosis/Paronychia

- Infection of nail and nailbed
- Very rare
- Often geophylic fungi
- Edema of nailbed with one to several brittle nails with onychodystrophy

Differential Diagnoses

- Patchy alopecia and scale: demodicosis, superficial pyoderma, cutaneous lymphoma
- Folliculitis/furunculosis: deep pyoderma
- Severe lesions +/-heavy crust: auto-immune diseases, drug eruptions
- Kerion: histiocytoma or other neoplasia
- Onychomycosis: SLO, vasculitis
- Paronychia: demodicosis, bacterial infection, allergy
- Pseudomycetoma: deep mycoses, atypical bacterial infections, neoplasia

Dermatophytosis - Diagnosis

- History and physical examination
- Wood's lamp examination
- Microscopic examination of fluorescing hairs
- Cytology
- Deep skin scraping
- Fungal culture and/or PCR
- Biopsy and histopathology – necessary for nodular form or atypical presentations

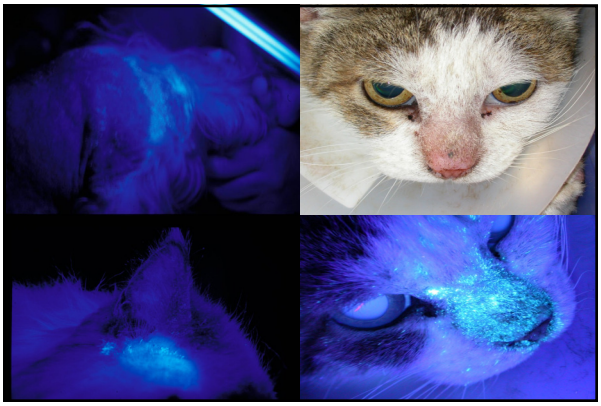
Wood's Lamp

- Valuable under utilized screening tool
- UV light lamp of 360 nm wavelength
- Plug in model with magnification preferred
- Darken room
- Examine at distance of 4-10 cm
- Must take time to thoroughly examine hair coat
- Need to be trained to recognize positive hairs

Burton UV Wood's light with magnification

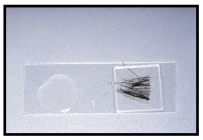
Wood's Lamp

- *M. canis* strains **commonly** fluoresce apple or blue green at shaft
- Identify infected sites that are not visible on gross clinical examination
- Valuable to select hairs for direct examination and culture
  - Positive hairs examined may **confirm** an infection
- False positives



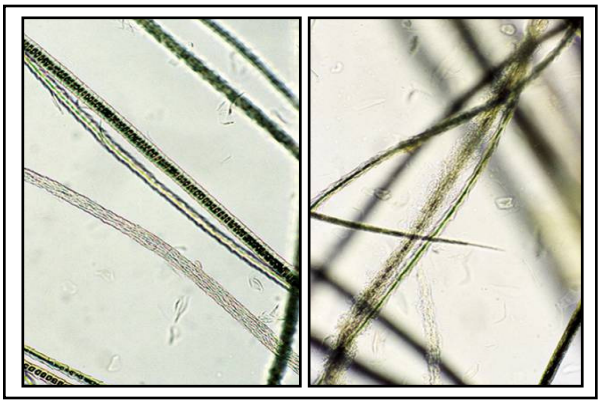
Microscopic Examination of Hairs (Trichoscopy)

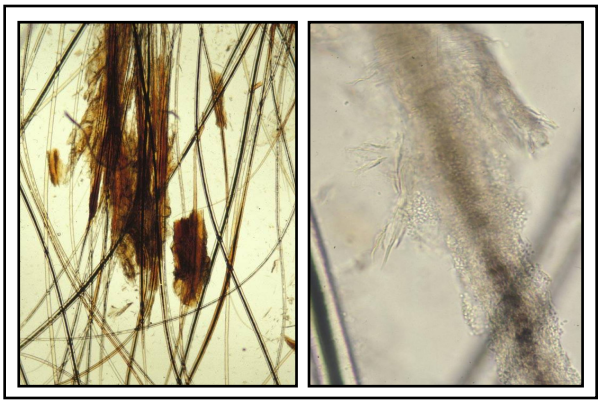
- Valuable in the rapid diagnosis of disease
- Pluck fluorescent hairs from the periphery
- Place hair on a slide with a drop of mineral oil +/- new methylene blue stain
- Cover with cover slip



Trichoscopy

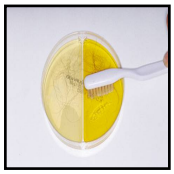
- Examine at 4x and 10x for "brush broken" hairs
- May use Wood's lamp to identify fluorescence in mounted hairs
- Examine at 40x for arthrospores
- May be positive in 60% or more of cases
- False positives: internal root sheath and keratin of follicular casts

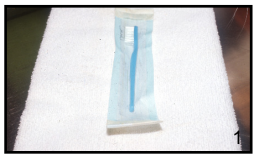


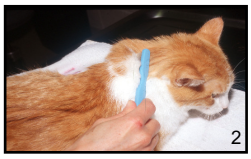


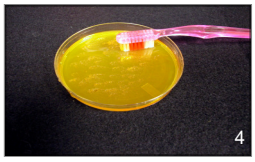
Fungal Culture

- Use sterile toothbrush and hemostat to pluck fluorescent hair
- Brush ~20 times until visible hair is sampled
- Sample lesional areas last
- Distribute material evenly on the plate to allow maximum contact
- Inoculate circular plate from center and continue in centrifugal direction or from top to bottom on split plate







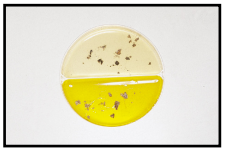


Fungal Culture Media

- Dermatophyte test media (DTM)
  - Contains phenol red as a pH indicator
  - Acids produced by catabolism of proteins turn media red
- Sabouraud's dextrose agar
  - Allows better evaluation of colony color and macroconidia
- Sab-Duet (DTM/Mycobiotic plates) or Derm-Duet

Onychomycosis - Culture

- Pluck hair from nailbed
- Chop nail keratin and broken nails on plate
- Scrape nail horn and inoculate on a plate

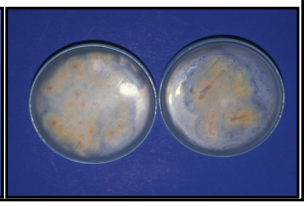


Fungal Culture

- Label bottom of plate and place in sealed plastic bag
- Incubate at or above room temperature (~75-80 F) for 21 days with medium side UP
- Examine daily, record growth and CFU weekly - DTM turns red **with** mycelial growth in 4-7 days = POSITIVE
- Pigmented fungi are not dermatophytes
- Some saprophytic fungi are positive for red color change; some dermatophytes are negative
- Must evaluate growth both macro **and** microscopically

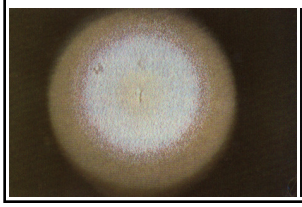
Macroscopic Identification

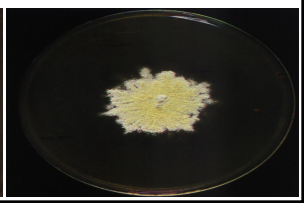
M. canis filamentous colony, white (front) to yellow-orange (rear) cottony or wooly flat mycelium



Macroscopic Identification

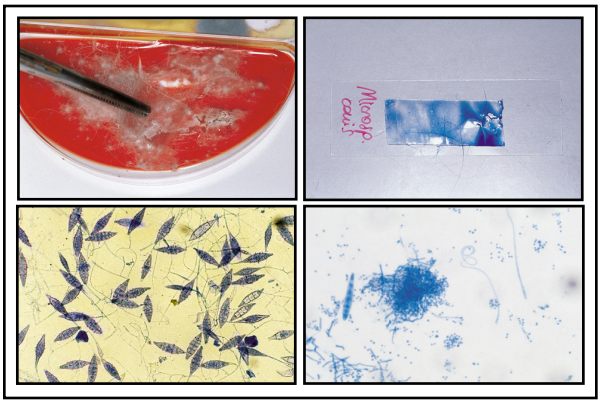
Trichophyton mentagrophytes has a thick downy colony, cream or pale brown (front) and yellow, rose, to reddish brown (rear), powdery and granular, with radiations



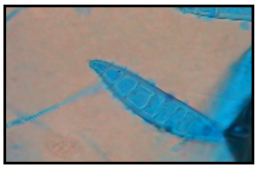


Microscopic Identification

- Wear gloves!
- Press clear acetate tape on colonies that are at least 5 days old
- Place a drop of lactophenol cotton or new methylene blue stain on a slide and allow to rest for 5-10 minutes
- Look carefully at 10x and 40x
  - Some *M. canis* strains do not produce macroconidia
  - *T. mentagrophytes* macroconidia are difficult to find

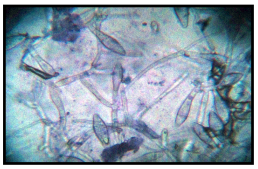


Microscopic Identification



Microsporum canis

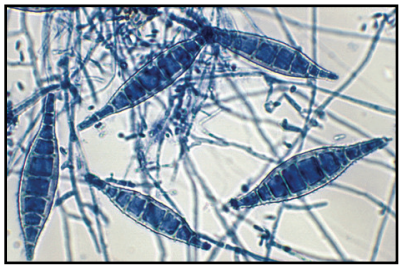
Macroconidia spindle-shape→
✓6 or more divisions
✓Thick cell wall with spines
✓End of conidia has a knob



Microsporum gypseum

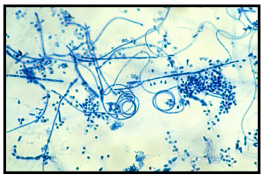
Macroconidia spindle-shape →
✓Less than 6 divisions
✓Thin cell wall and fewer to no spines
✓End of conidia is round

Microsporum canis



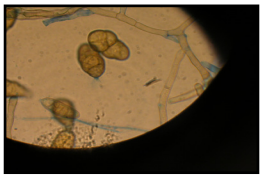
Microsporum gypseum

Microscopic Identification



Trichophyton mentagrophytes

Macroconidia – rare
Microconidia
✓Many and spherical
✓Hyphae → spiral shape → hard to find but very characteristic



Contaminant – dematiaceous mold

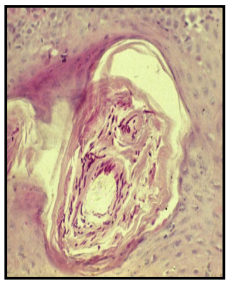
Pigmented macroconidia or microconidia indicate contaminant

www.doctorfungus.org

Base the diagnosis on color change, macroscopic and microscopic appearance of colonies

Pseudomycetoma - Diagnosis

- Skin biopsy
- Place half in formalin; half in sterile saline for fungal culture
- Request special stains for fungi (PAS, Gomori silver stain)
- Consider PCR



Newer Diagnostics

PCR

- Internal transcribed spacer (ITS) of ribosomal DNA is the genome fragment in most veterinary tests
- Ringworm RealPCR™ Panel offered by Idexx Laboratories includes *Microsporum* spp. and *Trichophyton* spp.
  - 95% sensitivity and 99% specificity (Idexx data on file) with results in 1-3 business days
- Sensitivity may be problematic as carriers will test positive
- Need additional prospective studies

Newer Diagnostics

Dermoscopy

- Examination of skin using skin surface microscopy
- Used for evaluation for tinea capitus and pigmented skin lesions in humans
- Allows for visualization of infected hairs which appear "comma-like"
- In one study, dermoscopy identified three cats with infected hairs not yet detectable by Wood's lamp
- In naturally occurring dermatophytosis, was positive in 21/36 with culture confirmed disease
- Useful in identification of hairs for direct examination and/or fungal culture

Courtesy Fabia Scarampella

Courtesy Fabia Scarampella

Dermatophytosis - Management

1. Reasonable confinement
2. Environmental cleaning and decontamination
3. Topical and systemic antifungal therapy
4. Monitoring until mycological cure

Management – Important Points to Emphasize

- Contracting dermatophytosis from casual contact with an infected environment is rare
- Dermatophyte spores are a dormant stage of the organism, **do not** live, grow or multiply in the environment
- Spores ≠ mold
- High humidity → increased spore death
- Spores may survive in dry setting for 12 months, but majority die within 3-6 months
- Spores are trapped by furnace filters and do not circulate via heating ducts
- Spores are easily removed from the environment

Management - Confinement

- Facilitates cleaning and limits spread to other animals
- Needs to be appropriate for kittens/puppies that require socialization/family bonding and older animals that may need close monitoring
- Some cats will not eat well in absence of owner

Management - Cleaning

- Removes infective material from environment and reduces false positive cultures
  - False positive culture results may unnecessarily lengthen confinement, treatment duration, side effects and cost
- Minimal impact on preventing infection of other animals and people
- *If it can be washed, it can be decontaminated!*

Management - Cleaning

- *Hard cleaning*: gross removal of organic material and debris via sweeping or vacuuming followed by thorough washing with detergent until visibly clean
- *One-step cleaners*: clean lightly soiled surface + sanitize in one step; still need to remove organic debris!
- In 1-2 cat households, thoroughly clean twice weekly with removal of cat hair and use "one step" cleaners daily

Choosing a Disinfectant

- Instruct client to read entire product label and safety data sheet (SDS)
- Choose a disinfectant with label claim of efficacy against *Trichophyton mentagrophytes*
- Apply generously with 10 minute contact time
- Active OTC ingredients include: sodium hypochlorite, quaternary ammonium, lactic acid, AHP and ethoxylated alcohol mixture

Effective Disinfectants

- Sodium hypochlorite (bleach): 1:10 to 1:32
  - Short contact time but needs to be made fresh and used immediately
  - No detergent properties, may react with other agents and produce toxic gases, unpleasant odor, damage to surfaces including floor finishes, discoloration of fabrics
- Enilconazole
  - Concentrated spray and fogger (Clindafarm®)
  - Not available in reasonably priced small volume

Effective Disinfectants

- 10 minute contact time
- Accelerated Hydrogen Peroxide (AHP; Rescue® Virox Animal Health, others)
  - Becoming more available and very effective
  - Contains surfactants, wetting and chelating agents
- Potassium peroxymonosulfate (Trifectant® Vetoquinol)

Decontamination Recommendations

- Hard, non-porous surfaces: perform 1-2x week

  (1) Remove debris (2) Wash with soap and water until visibly clean (3) Rinse well (4) Apply disinfectant (5) Remove debris and use one step cleaners and dusting between hard cleanings
- Wood floors – remove debris and wash well
- Walls, windows, ledges - remove dust, etc. with Swiffer duster (hard clean if multicat household)

Decontamination Recommendations

Soft surfaces, laundry

1. Change blankets/bedding daily
2. Store exposed laundry in plastic bag and separate from other items
3. Use hot or cold water +/- bleach (1 cup/tub)
4. Do not overfill – agitation is important
5. Use longest wash cycle and highest water level available
6. Wash twice if large amount of hair is visible
7. Wash pet laundry at end of day
8. Mechanically clean laundry basin and lint trap
9. Spray basin with disinfectant and run load with water only

Decontamination Recommendations

Carpets

- Difficult so best to limit contact with infected animal
- Steam cleaning may be effective - 95% of spores were removed 48 hours post cleaning
- If wash, need to thoroughly wet

1. Vacuum to remove debris and hair
2. Thoroughly spray with disinfectant, use brush to scrub, allow 10 min contact time
3. Use carpet scrubber to wash carpet
4. Rinse the carpet with water until no foam is visible
5. May have massive sporulation on surface in 48 hrs → exposure risk

Decontamination Recommendations

- Bowls, litter boxes, pet carriers – wash twice using hot water, dish soap or a detergent and rinse well
- Dispose:
  - Cat posts unless fairly new with limited exposure and may be decontaminated
  - Pet clothing
  - Non-metal collars

Dermatophytosis - Therapy

- No therapy?
  - Spontaneous resolution in 70-100 days in *healthy* cats
- Why treat?
  - Speed resolution of infection
  - Avoid infection of other animals/humans
  - Limit environmental contamination and false positive culture results
- Use combination of topical and systemic therapy

Why Topical Treatment?

- Only means of killing spores on hair coat
  - Limit spread of disease via direct contact
  - Minimize spore deposition in environment and the risk of false positive cultures
- Necessary and important part of treatment
- Lime sulfur and enilconazole are best options
- Comb prior to application of topical therapy

To Clip or Not To Clip?

- Grossly reduces amount of infective material
- May require sedation
- Increase microtrauma and/or cause thermal burns → spreads infection
- Whole body clipping recommended
  - Hair coat is matted, long hair with extensive lesions, soaking of hair coat is difficult, poor response to treatment
- Best to use scissors vs. clippers
- Infected whiskers may be clipped or plucked (if limited)

Topical Therapy

- Whole body rinse
  - **Lime sulfur** (1:16), enilconazole (1:100), accelerated hydrogen peroxide (3.5% diluted 1:10)
  - Perform twice weekly
- Shampoo
  - Ketoconazole or miconazole 1-2% +/- chlorhexidine
  - Climbazole 0.5%
  - Dilute >/= 1:10 with 3 minute contact time
- Climbazole 0.5% mousse

Topical Therapy

- Adjuvant focal therapy for areas difficult to bathe/rinse or remain positive
  - Climbazole 0.5%, terbinafine 1% (human product), thiabendazole, clotrimazole, ketoconazole or miconazole at > 1%
  - Vaginal miconazole may be used around the face/eye areas

Why Systemic Therapy?

- Treatment of choice
- Only means of killing spores in hair follicle and nails
- Dermatophytes may be cultured on non-lesional skin
- Shortens treatment time in combination with topical therapy
- Reduces environmental contamination in combination with topical therapy

Systemic Therapy

- Itraconazole 5 mg/kg PO once daily
  - Available as tablet (100 mg), oral solution (10 mg/ml) and generic capsule (100 mg)
  - Fungicidal
  - Concentrates in keratin and sebum, allows alternate day/week treatment (one week on, one week off for six weeks)
  - Do not compound!
  - May be expensive
  - Side effects: increase in ALT correlates with toxicity, anorexia, vomiting, weight loss
  - Perform chemistry (ALT at minimum) once monthly during treatment

Systemic Therapy

- Fluconazole: 5-10 mg/kg PO once daily
  - Available as generic tablet (50, 100, 150 and 200 mg) and powder for oral suspension (10 and 40 mg/ml)
  - Fungistatic
  - May need to reduce dose in cats with renal impairment
  - Side effects: inappetence, vomiting, diarrhea, hepatotoxicity (very rare)

Systemic Therapy

- Ketoconazole 10 mg/kg once daily
  - Available as generic 200 mg tablet
  - Fungistatic
  - Side effects: hepatotoxicity, anorexia and emesis, inhibition of adrenocortical gland function
  - Contraindicated in pregnancy and during the first 6 weeks of age
  - Controversial in cats due to potential for side effects

Systemic Therapy

- Terbinafine HCl: 30-40 mg/kg PO once daily
  - Available as film coated oral granule (125 and 185 mg/packet) and generic tablet (250 mg)
  - Fungicidal
  - Accumulates in high concentrations in sebum, stratum corneum and hair follicles and persists for 2-3 weeks after drug withdrawal
  - Alternate day/week therapy as with itraconazole
  - Side effects: vomiting and intense facial pruritus reported

Systemic Therapy

- Micronized griseofulvin – 25-50 mg/kg PO once-twice daily
  - Available as 125 and 250 mg capsule and 125 mg/5 ml suspension
  - Fungistatic
  - Avoid in young (< 6 weeks) or immunosuppressed cats
  - Administer with fatty meal to increase absorption
  - Active in the stratum corneum for 36-72 hours
  - Side effects: teratogenic, myelosuppressive, gastrointestinal
  - Perform CBC monthly

What About A Vaccine?

Safe and effective vaccine
is not available

Therapy - Monitoring

1. Examination for presence or absence of lesions
2. Examination with a Wood's lamp
3. Fungal culture with CFU count

Management - Monitoring

- CURE = clinical + mycological cure
- Number of CFU on a fungal culture plate = stage of infection - important in monitoring
- Clinical cure precedes mycological cure
- Treat until at least two negative fungal cultures at 1-2 week intervals

Normal Skin but Persistent Positive Culture?

- Environment and/or fomite contamination (not true infection)
- Remaining subclinical lesion that has not healed
- Persistence of infective spores on distal portion of hair shaft
  - Most common in areas that are difficult to treat (face, ears)
  - Consider clipping fur with scissor or adjuvant topical therapy

Dermatophytosis - Key Points

- Important risk factors involved in the development of dermatophytosis
- Clinical signs vary and may be relevant to treatment
- Use your Wood's lamp!
- New diagnostic tests are promising
- Prescribe both oral and topical therapy whenever possible
- Management is not as difficult as we once thought