FELINE INFECTIOUS DISEASES

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August 4-8, 1994

Sheraton Inn
Ithaca, New York

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Feline Practitioners Seminar and Specialty Board Review
Cornell University
Ithaca, New York
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I. INTRODUCTION:

II. FELINE INFECTIOUS PERITONITIS AND OTHER FELINE CORONAVIRUS INFECTIONS OF THE CAT

A. Historical

1. First described in early 1960s, by Dr. Jean Holzworth
2. Named in mid-1960s
3. Immunopathological component identified
4. Antibody-dependent enhancement (ADE)
5. First vaccine - intranasal MLV - 1991

B. Current status

1. THE most feared disease today in breeding catteries
2. less common and of less concern in the general pet population
3. no effective treatment for FIP - nearly 100% fatal
4. commercial vaccine less than 100% effective
5. laboratory tests for coronavirus antibodies not specific for FIP
6. no test for FIP antigen, virus, or to identify virus carrier cat
7. difficult to handle a cattery enzootic of FIP
8. incubation period may be weeks, months, or even years

C. Pathogenesis

1. incubation period = weeks, months, or even years - generally 2-3 weeks
2. Local infection or primary infection
   a. pharyngeal and lung epithelium
   b. intestinal epithelium (?)
3. minimal clinical disease occurs during the primary infection, often just a transient fever for one to a few days
4. antibodies against FIPV first appear in serum by day 7 to day 10 after infection
5. infection of macrophages with virulent FIPV
   a. Fc receptors on macrophage enable uptake of virus/antibody complexes
   b. infected macrophages transport the virus throughout the body
6. Secondary infection then occurs in many tissues, with macrophages attaching to and migrating through the walls of veins. A perivascular reaction occurs, leading to development of a pyogranuloma, the basic lesion of FIP within tissues. In wet FIP there is an exudative reaction at the vessel walls, with exudative fluid accumulating in the peritoneal and/or the thoracic cavities.
7. insidious increase in clinical signs
   a. anorexia
   b. weight loss with rough hair coat
   c. persistent, nonresponsive fever
   d. depression
   e. exudative fluid in peritoneal, thoracic, or pericardial cavities in wet FIP

f. Death

8. duration of clinical disease = a few days to several months

D. **Transmission**

1. Hök study - Sweden (*Hök, Acta vet. Scand. 34:345-356, 1993*)
   a. Contact trasmission - 2 FCoV positive cats (Source cats) in contact with 3 SPF cats (Recipients) and kittens raised from study cats (Offspring).
   b. First clinical signs in 3 Recipients 11, 13, & 18 days after contact with source cats
   c. 2 years after contact, 2 Recipients started to breed - 37 kittens in 7 litters
   d. Offspring developed disease 4-5 weeks of age
   e. Pattern of recurring upper respiratory disease & conjunctivitis every 4 months - both Recipients and Offspring
   f. CNS signs and wasting, fatal FIP in some cats
   g. FCoV antigen persisted in membrana nictitans throughout study
   h. FCoV antigen in all tissues in all cats that died
   i. Intrauterine infection - newborn kittens had FCoV antigen
   j. 1/2 Source cats had 2 bouts of clinical disease (fever, matted fur, conjunctivitis, diarrhea) coincident with bouts of disease in Recipient cats - she died of FIP 5 months after start of study
   k. Offspring
      - all but 3 surviving kittens positive for FCoV antigen at first IFA test when eyes opened
      - 1st clinical disease at 25 days of age
      - usual onset of disease at 4-5 weeks of age = conjunctivitis, rhinitis, sneezing, fever spikes,
      - signs lasted for 2-4 weeks
      - 1-4 relapses occurred in 20 kittens, starting at age 3-5 months
      - death occurred at 2 age periods
        - 1-12 days of age (9/37) = approximately 25%
        - 3-5 months (9/25) = approximately 25% of total
2. Addie & Jarrett study, Scotland
3. Stoddart & Scott study, Cornell

E. **Wet vs. Dry Forms of FIP**

1. early reports, primarily wet (exudative) FIP
2. currently, dry form of FIP is more common than the wet form
3. the "wet" and "dry" forms of FIP are merely variations of the same disease process

F. **Virus Shed**

1. FIPV shed = day 1 to day 10 after infection in saliva (up to day 14 in feces)
2. Clinical disease usually not present when cat is shedding virus
3. Cats with clinical disease no longer shedding virus
4. Virus persists within the cat in blood and tissues - detected by PCR

5. Isolation of virus from clinical cases of FIP is very difficult
6. Carrier healthy cats, including queens
7. Method of transmission from carrier cat is unknown at present.

G. **Relationship of FIPV to FeLV and FIV**
   1. All 3 viruses are distinct and produce clinical disease by themselves
   2. Both FeLV and FIV are immunosuppressive viruses.
      a. predispose cats to other opportunistic infections
      b. can cause a recrudescence of latent infections
   4. Originally, 40 to 50 % of FIP cases occurred in FeLV-positive cats. Today, far fewer cases occur in FeLV-positive cats.
   5. no predisposition of FIV to cause FIP

H. **FIP Virus**
   1. properties of FIPV
      a. coronavirus
      b. pleomorphic enveloped virus
      c. single-stranded, positive-sense RNA genome
      d. three major structural proteins
         (1). "N" or nuclear protein = core protein
         (2). "M" or matrix glycoprotein (formerly called E1) = envelope glycoprotein
         (3). "S" or spike glycoprotein (formerly called E2) = spike glycoprotein
   2. cell receptors
      a. receptors for epitopes on S protein
      b. Fc receptors on macrophages for Fc portion of IgG antibodies
   3. replication of FIPV occurs at the endoplasmic membranes
      a. virus buds into vacuoles within the cell cytoplasm
      b. virus remains cell-associated initially
      c. virus released from cell after the cell is destroyed (cytolysis)
      d. replication of virus is rapid - complete cycle requires <24 hours
   4. infectivity of FIPV in environment
      a. survives in the environment much longer than was originally thought
      b. infectious FIPV recovered from contaminated dry surfaces for 3 to 7 weeks
      c. The amount of infectious virus recovered decreases with time

I. **FIPV, FECV, CCV, and TGEV**
   1. 4 viruses make up an antigenic cluster - genomes very similar
   2. Feline enteric coronavirus (FECV)
      a. generally produces mild enteritis, but not FIP
      b. some indication that FECV can produce FIP-like disease
      c. positive antibody titers against FIPV
   3. Canine coronavirus (CCV)
      a. CCV can infect cats, usually with subclinical infection
      b. CCV antibody-positive cats can have ADE of FIPV infection

c. UK isolate of CCV can produce clinical FIP
d. positive antibody titers against FIPV

4. Transmissible gastroenteritis virus (TGEV) of swine
   a. TGEV can infect cats, usually with subclinical infection
   b. positive antibody titers against FIPV

J. **FIPV Type 1 and Type 2**

1. Monoclonal antibody studies and culture properties of isolates indicate two types of FIPV
   a. FIPV type 1 = strains UCD-1, UCD-2 (?), UCD-3, UCD-4, Black (TN-406), FECV-UCD, NW-1
      - difficult to grow in cell culture, poor cytopathogenicty
      - extremely difficult to culture from clinical cases
      - low titers produce in cell culture

   b. FIPV type 2 = strains 1146, FECV-1683, DF2
      - readily grow in cell cultures, with high titers and good CPE
      - resemble canine coronavirus (CCV)

2. Epitopes associated with neutralization are located on S protein
   a. Epitope I and II distinct
   b. Epitope III overlaps both I & II
3. Hohdatsu studies in Japan
4. Pedersen studies in California
5. Jacobson studies at Cornell

K. **Diagnosis**

1. Clinical signs
   a. persistent, non-responsive fever
   b. gradual weight loss,
   c. progressive anorexia and depression
   d. various other clinical signs, depending on location of lesions. With fluid accumulation in the abdominal cavity, moderate to marked ascites occurs. If the fluid is in the thoracic cavity, progressive dyspnea occurs. Involvement of the kidneys can result in signs of renal failure and toxicity, while involvement of the central nervous system produces various neurological signs. Liver disease is a common occurrence in FIP.
2. Clinical pathological findings
   a. elevated total serum protein
   b. elevated liver enzymes
   c. elevated bilirubin
   d. altered electrophoretic pattern of the serum globulins
   e. leukocyte counts are variable and thus not predictive of FIP
3. Evaluation of abdominal and/or thoracic fluid if present (wet FIP)

a. can confirm the diagnosis of FIP
b. a viscid, egg-white consistency
c. flecks of fibrin floating within the fluid
d. FIP fluid usually will clot on standing
e. a high specific gravity (above 1.018 and often above 1.030)

4. Serological assays for the presence of coronavirus antibodies
   a. controversial
   b. available tests detect antibodies against various coronaviruses
   c. not specific for FIP
   d. tests are not diagnostic in themselves
   e. positive coronavirus antibody tests, however, are consistent with FIP
   f. some severe cases of clinical FIP will have negative antibody titers
5. Histopathological findings
   a. histopathology is the most accurate method of confirming a diagnosis of FIP
   b. typical lesions (typical pyogranulomatous reactions) are diagnostic for FIP
   c. Samples may include biopsies of affected organs, or tissues with lesions collected at necropsy.
6. Polymerase chain reaction (PCR)
   Li & Scott, 1994; PAL News 3(2), Spring/Summer 1994
   a. appears once infected with virus, will test positive by PCR.
   b. specificity depends on probe used for PCR
   c. blood can be use to test
   d. commercially available by California laboratory (PAL)
   e. regretfully, interpretation may have same limitations as serological tests
7. IFA assay of membrana nictitans
   a. Natural transmission study - FCoV positive cats to SPF cats and to offspring
   b. Developed IFA test of membrana nictitans
   c.

L. **Serological Tests**

1. All tests are antibody tests
   a. FIPV vs. CCV vs. TGEV
   b. ELISA vs. kinetics ELISA (KELA)
   c. IFA
2. Titer vs. just "positive"
3. Accuracy of serology
   a. non-specific background reaction
      - up to 30% of positives - Jacobson, Cornell Univ.
   b. recent vaccination against any disease - cell culture vaccines
   c. only indicated previous coronavirus infection, not necessarily FIPV
   d. use as screening and indication only, not diagnostic
4. Height of coronavirus antibody titer - over emphasized
   a. healthy cats
      - little predictive or diagnostic value

- either "positive" or "negative"
- only tell if cats have been infected with a coronavirus sometime in the past.

b. sick cat
- more predictive value
- titer > 1:400 is consistent with FIP, but still is not diagnostic
- titer < 1:400 indicates that the disease in question probably is not FIP
- some cases of fatal FIP have negative or low titers

c. When in doubt, rely on clinical signs and clinical pathological results rather than the results from coronavirus antibody tests.

5. Addie & Jarrett in Scotland claim to have test that will separate wet and dry forms of FIP (*Vet. Rec. Apr. 2, 1994*)
6. To test, or not to test?
   a. should be used in many cases
   b. should not be over-interpreted
   c. screening test to determine the presence of coronavirus in a group of cats
   d. used as an AID (and only an aid) in diagnosing clinical FIP
   e. Repeat testing in a FIP antibody-positive cattery or multicat household is not recommended or warranted.

M. **Immunology of FIP**
1. Humoral Immunity
   a. Serum VN antibodies first appear about at 7 to 10 days after infection.
   b. Gradual increases in VN titers until 5 to 6 weeks after infection.
   c. hypergammaglobulinemia
   d. VN antibodies = enhancing antibodies generally
   e. subclass of IgG may be important
2. Cell-Mediated Immunity
   a. believed be play an essential role in immune response
   b. details of CMI not developed
3. Local immunity
   a. IgA on mucosal surfaces may prevent infection

N. **Immune Enhancement (Antibody-Dependent Enhancement, ADE)**
1. Antibody results in enhanced infection of macrophages via Fc receptors
2. The infected macrophages then transport the virus throughout the body
3. decrease incubation time - as short as 1 to 2 days - after exposure to virulent FIPV
4. dose of virus and antibodies important for ADE
5. CCV can cause ADE as well as FIPV strains

O. **Role of the Macrophage**
1. Infectivity of macrophages = key to the ability of FIPV to become systemic
2. develop perivascular lesions = pyogranuloma

P. **Vaccination**

1. Primucell FIP
   a. MLV temperature sensitive mutant
   b. intranasal vaccine
   c. 2 doses 3-4 weeks apart, starting at 16 weeks of age
   d. stimulates local IgA and VN antibody titers in serum
   e. VN antibodies are also enhancing antibodies
   f. efficacy depends on dose of FIPV exposure
      - low dose exposure - partial protection
      - high dose exposure - no protection, and enhanced disease
      - normal exposure dose in nature is unknown at this time

Q. **Treatment of FIP**
1. almost invariably discouraging
2. no specific antiviral compounds available
3. aimed at support and possibly alteration or modification of the immune response
4. good nursing care
5. if only ocular involvement, local or subconjunctival therapy with corticosteroids

R. **Husbandry**
1. Carrier queens (?) - appear to be key to transmission in catteries
2. early weaning - 5 weeks of age = key to breaking vertical transmission
3. raise litter isolated from other cats including queen
4. test for CV antibodies at 12-16 weeks of age before kittens are sold
5. test all cats unvaccinated for FIP before enter cattery or multicat household

III. RESPIRATORY INFECTIONS

A. **Historical**
1. Very important in clinics, shelters, catteries, and farms
2. Vaccines developed for FVR, FCV, and feline chlamydia

B. **Current status**
1. vaccines have greatly reduced incidence of severe infection
2. respiratory disease still very important in breeding catteries and open multicat facilities

C. **Etiology/disease**
1. Viruses
   a. feline herpesvirus type 1 (FHV-1)/feline viral rhinotracheitis (FVR)
   b. feline calicivirus (FCV)/feline calicivirus infection (FCVI)
   c. feline reovirus/reovirus infection, URI
   d. feline infectious peritonitis (FIP) virus/FIP, mild URI
   e. feline immunodeficiency virus (FIV)/immunodeficiency, 2nd infections
   f. feline leukemia virus (FeLV)/thymic lymphoma, immunodeficiency, 2nd

infections

2. Bacteria
   a. *Bordetella bronchiseptica*/bronchial pneumonia
   b. *Pasteurella multocida*/URI, cat bite abscesses (cats & humans)
   c. Streptococcal infections/URI, pharyngitis, sinusitis
   d. *Yersinia pestis*/feline plague
   e. *Haemophilus felis*/chronic obstructive pulmonary disease
   f. *Rochalimaea henselae* (*Afipia felis*)/cat-scratch disease in humans, subclinical infection? in cats
   g. *Nocardia spp*/nocardiosis
3. Mycoplasma
4. Rickettsia & Chlamydia
   a. *Chlamydia psittaci* (feline pneumonitis agent)/feline chlamydiosis (pneumonitis)
   b. Q fever/subclinical infection
5. Fungi
   a. *Blastomyces dermatitidis*/blastomycosis
   b. *Cryptococcus neoformans*/cryptococcosis, URI
   c. *Aspergillus fumigatus*/aspergillosis, pneumonia
   d. *Histoplasma capsulatum*/pulmonary histoplasmosis
6. Protozoa
   a. *Toxoplasma gondii*/toxoplasma pneumonia

D. **FELINE VIRAL RHINOTRACHEITIS** (FVR, "rhino", coryza)

A common, acute herpesvirus disease of domestic and exotic cats characterized by upper respiratory disease (sneezing, rhinitis, conjunctivitis), ulcerative keratitis, and fever.

1. **Etiology**
   a. Herpesvirus
      - typical alphaherpesvirus
   b. - 1 Serotype
2. **Hosts**
   a. All Felidae
3. **Distribution**
   a. Widespread = Worldwide
4. **Transmission**
   a. Contact
      - acute disease
      - latently infected queen
   b. Aerosol
5. **Pathogenesis**
   a. Incubation = 3 to 5 days
   b. Acute upper respiratory infection

- sneezing
- ocular and nasal discharge
- ulcerative keratitis

c. Fetal infection
- abortions
- neonatal systemic disease

d. Latent infections

6. **Laboratory diagnosis**
   a. Viral isolation
      - nasal or pharyngeal swabs
      - nasal turbinates
   b. Immunofluorescence - nasal scraping
   c. Histopathology
      - intranuclear inclusions in nasal turbinates
7. **Prevention and control**
   a. Recovered cats are latently infected
   b. Immune response poor - recurrent infections
   c. Management and hygiene
   d. Vaccination (cats should be routinely vaccinated)
      - parenteral
      - MLV - intranasal vaccine
      - inactivated - parenteral
   e. Combined vaccines (FCV, FP, rabies?, FeLV)

E. **FELINE CALICIVIRUS**
1. **Synonyms**
   a. Feline "picornavirus"
      - old term, there are no known picornaviruses of cats
   b. FCV
   c Feline calicivirus disease (FCD) or infection (FCI)
2. **Etiology**
   a. **Feline calicvirus**
      - formerly classified as a picornavirus genus
      - one main serotype with many subtypes of varying degrees of cross reactivity.
      - one or more addition serotypes identified
      - typical calicivirus properties
3. **Hosts**
   a. Felidae - domestic and wild
4. **Distribution**
   a. World-wide - very common infection
5. **Transmission**
   a. Direct contact
   b. Aerosol
   c. Fomites, people

d. Carrier cats

6. **Forms of Disease**
   a. **Upper respiratory**
   b. **Ulcerative**
   c. **Pneumonia**
   d. **Enteritis**
   e. **Arthritis**
7. **Pathogenesis**
   a. Incubation = 3-5 days
   b. Local infection of oral and nasal epithelium
   c. Topical spread - URI, ulcers, conjunctivitis
   d. Viremia
   e. Pneumonia
   f. Enteritis (?)
   g. Acute arthritis
   h. Course of disease is from 1-10 days (usually about 7)
   i. No corneal ulcers, minimal sneezing, and prominent tongue ulcers - in contrast it to FVR
   j. Mortality = 0-30%
8. **Laboratory diagnosis**
   a. Viral isolation - readily isolated from throat swabs
   b. FA of lung - identify virus
   c. SN on paired sera - antibody titer rise
9. **Control**
   a. Recovered cats are immune, but can get local reinfection
   b. Carrier cats - recovered cats are persistent virus shedder from oral pharynx
   c. Vaccines - routinely used in combination with FVR and FP
      - MLV parenteral
      - MLV intranasal
      - inactivated parenteral
   d. Husbandry

IV. CONTROL OF FELINE INFECTIOUS DISEASES WITHIN CATTERIES, SHELTERS, AND MULTICAT HOUSEHOLDS

A. Historical

1. over 50% of cats from shelters developed FP or severe URI
2. boarding cats in clinics often disastrous because of URI
3. raising kittens fraught with problems from infectious diseases
   a. URI or "pneumonitis"
   b. leukemia
   c. panleukopenia
   d. numerous other infectious diseases; ringworm, hemobartonella
4. little information about effective disinfectants

5. lack of effective vaccines

B. **Current Status**
   1. situation much improved in multicat facilities
   2. Yet, infectious diseases are potentially serious problems whenever numerous cats are assembled.
   2. Viruses, bacteria, protozoa, and other infectious agents cause mild to serious, and even fatal, infections in cats. While some infections are difficult to control,
   3. In most cases, the infections can be controlled with a combination of knowledge about the disease and agent involved, proper management of the cats, and appropriate preventive health measures including vaccinations.

C. **Types of Multicat Facilities**
   1. **Catteries** = facilities where 3 or more breeding queens are maintained for the purpose of rearing kittens.
      a. within individual household
      b. cats housed in a separate building
      c. large, commercial catteries or cat colonies

   2. **Shelters** = public or private facilities whose purpose of existence is to find homes for unwanted pets, in this case, cats.
      a. municipal facilities of a city, town, or county
      b. private shelters
         (1). in-home "shelters" - often a disaster
         (2). larger, incorporated private shelters - many excellent facilities
   3. **Multicat households** (MCH) = 3 or more cats present at any given time.
      a. free-roam household
      b. restriction of cats to individual rooms, a converted garage or barn, or a specially built facility.
      c. A MCH differs from a cattery in that cats are usually neutered and thus kittens are not raised.

   4. **Farms** = agricultural facilities where cats have free roam of the buildings and land, and they may even be feral. The cats are utilized for rodent control, often they are not neutered, and preventive care and care in general may be minimal or non-existent.

D. **General Principles of Control of Infectious Diseases**
   1. **Transmission**
      a. direct contact, or nose-to-nose transmission
      b. contaminated objects such as feed dishes, water bowls, litter pans, floors, resting boards, or furniture
      c. aerosol transmission
      d. vertical - from a carrier or latently infected queen to her kittens.

e. in utero

2. **Persistently infected and latently infected cats**
   a. FCV - persistent shed of virus from oropharynx
   b. FHV - intermittent shed of virus from oropharynx - latent infection
   c. FeLV - persistent shed of virus in saliva
   d. FIV - persistent, low level of virus in saliva, blood
   e. FIP - carrier cats believe to occur - details = ?

E. **Barriers against transmission of infectious agents**
1. effectiveness: distance > physical walls > > cages > fences
2. The greater the degree of separation, or the better the physical barrier between an infected cat and a susceptible cat, the less the chance that transmission of the infectious agent will occur.
3. Separate buildings are better than separate rooms within the same building, separate rooms are better than separate cages within the same room, and individual cages in turn are better than having cats within the same run or cage.
4. Wire cages that allow nose-to-nose contact through the wire may prevent those diseases that usually are transmitted by biting such as feline immunodeficiency virus, but these wire cages will do little to prevent the rapid transmission of infectious respiratory agents such as feline herpesvirus and feline calicivirus.

F. **Transmission of infectious agents by people**
1. often the weak link in controlling infectious diseases in animals
2. contaminated hands, shoes, or clothing
3. source of the virus
   a. acutely ill cat
   b. an infectious cat during the incubation period
   c. a "healthy"-appearing chronic carrier cat
4. simple procedures to reduce the risk of a disease outbreak
   a. caring for clean or noninfected cats before caring for infected cats
   b. washing hands thoroughly after handling infected cats
   c. changing shoes or disinfection of footwear as one leaves a contaminated area
   d. changing outer clothing after handling infected cats

G. **Four aims for controlling infectious diseases within multiple cat facilities**
1. **Establish an immune population of cats through appropriate vaccination.**
   a. Early vaccination for FHV & FCV
      - 4-5 weeks of age, then every 4 weeks until 14 weeks of age
      - IN respiratory vaccine at 2 weeks of age, then regular vaccine every 4 weeks
   b. FPV at 6, 10, & 14 weeks
   c. Booster vaccine every 1-3 years
   d. Regular vaccines as appropriate - FeLV, FIP, rabies, chlamydia
   e. vaccinate shelter or random-source cats immediately with MLV vaccines for FPV, FHV, & FCV
2. **Separation of infected and susceptible cats**
   a. isolation or quarantine of new cats

- at least 3 weeks
- monitor carefully for clinical disease
- tested for infectious diseases

b. immediate isolation of all cats showing signs of infectious disease
- treat until no longer infectious
- culled from the population if the situation warrants

3. **Reduce the number of latently infected and persistently infected cats**
   a. serve as a nidus of virus
   b. identify "healthy" carrier cats whenever possible
   c. prevent carrier cats from coming in close contact with susceptible cats
4. **Eliminate or reduce the amount of infectious agent in the environment**
   a. proper disinfection of floors, cages, resting boards, litter pans, and food/water dishes
   b. adequate ventilation to remove virus particles from the air

H. **Infectious Diseases Involved**
1. **Feline leukemia virus (FeLV)** - lymphosarcomas, chronic enteritis, anemia, and immunosuppression
2. **Feline immunodeficiency virus (FIV)** - immunosuppression and an AIDS-like disease after several years of incubation
3. **Feline herpesvirus (FHV)** infection (feline viral rhinotracheitis, FVR) - clinical disease includes sneezing, ocular and nasal discharge, crusty eyes, fever, occasional ulceration of the cornea of the eye, and depression
4. **Feline calicivirus (FCV)** infection - mild upper respiratory infection (ocular and nasal discharge), ulcerations (tongue, mouth, and possibly on the nose), pneumonia (sometimes fatal), acute arthritis with joint pain, high fever, and enteritis.
5. **Feline chlamydiosis** (feline pneumonitis) - upper respiratory infection or pneumonia, chronic ocular and/or nasal discharge, chronic bronchitis, and pneumonia
6. **Feline parvovirus (FPV)** infection (**feline panleukopenia = FP**) (also known as feline "distemper" or feline infectious enteritis) - a highly contagious viral disease of cats - THE most serious disease in unvaccinated populations of cats - characterized by a sudden onset, complete inappetence, severe depression, severe dehydration with sunken eyes, acute diarrhea, and high mortality in young kittens
7. **Feline rabies** - fatal neurological disease
8. **Feline infectious peritonitis (FIP)** - common coronavirus infection of cats - subclinical infection, or fatal disease with insidious onset, persistent fever, inappetence, progressive weight loss, and sometimes a progressive accumulation of fluid in the abdomen (ascites) and/or the chest cavity

I. **Catteries**
1. present special problems associated with the raising of kittens
2. latently infected or persistently infected queens - FHV, FCV, FeLV, and presumably FIP

3. can have high kitten mortality
4. shows and exchange of cats for breeding
5. test all cats for FeLV and FIV
6. maintain only feline coronavirus negative cats (?)
7. routine vaccination against FPV, FHV, and FCV
8. vaccination against feline chlamydiosis, FeLV, FIP, and rabies as indicated.
9. early vaccination
10. early weaning
11. Breeding catteries should have 5 separate rooms or facilities
    a. main cattery room
    b. room for pregnant queens and queens with nursing kittens
    c. weaned kitten room
    d. a quarantine room for incoming cats
    e. an isolation room for any infected cats

J. **Cattery Inspections**
1. CFA's Approved Cattery Environment Program (ACEP) - cattery inspection by licensed veterinarians using criteria established by CFA. Effective July 1, 1992.
    a. *Approved Cattery* - score 2.0-3.099
    b. *Cattery of Excellence* - score 3.1-4.0
    c. Unapproved - score <2.0
    d. Mandatory cattery inspection for all catteries that submit 75 or more kitten registrations per year

K. **Adoption Shelters**
1. spectrum of facilities
    a. small private shelters within homes
    b. large corporate shelters with numerous personnel & large facilities
2. degree and quality of control of infectious diseases
    a. complete spectrum - almost non-existent to very effective
    b. small, private shelters - often disastrous
    c. shelters with multiple personnel should establish a written policy or procedure for operation of the shelter that includes detailed procedures aimed at control of infectious disease.
3. Each shelter should have a minimum of 3 rooms or areas for housing cats
    a. <u>main room(s)</u> - to house healthy kittens and adult cats that are ready for adoption. If possible, divide into units of no more than 10 cats.
    b. <u>quarantine room</u> for healthy-appearing cats that are entering the facility. Cats caged individually or as litters of kittens.
        - Cats entering the facility should be examined as soon as possible, with euthanasia of unadoptable cats as appropriate.
        - screen test for FeLV, and possibly FIV
        - vaccinate immediately!!
        - place in recently disinfected cages

- New cats should remain within the quarantine area as long as possible before entering the main adoption facility - 14 days if possible.

c. isolation room for housing sick cats
- must NOT be used for the quarantine room for entering healthy cats
- Sick cats should be treated and held in isolation until they are judged healthy and ready for adoption
- Incurably ill cats and cats judged to be persistently positive for FeLV should be humanely euthanized.

L. **Multicat Households (MCH)**
1. Homes having 3 or more cats but without an active breeding program.
2. Infectious diseases are not as prevalent as long as the cat population is stable.
3. Introduction of stray cats - good Samaritan syndrome
4. Prevention of infectious diseases in a MCH
   a. maintaining a properly vaccinated group of cats
   b. complete avoidance of introduction of new cats unless they have been isolated in quarantine for 4-plus weeks, and have been tested negative for FeLV, FIV, and FIP.

M. **Farms**
1. difficult situation to control infectious diseases
2. outdoor, free roaming cats
   - contact other cats
   - contact wildlife
   - often feral and wild
3. minimum vaccination program should include
   - FPV, FHV, and FCV in kittens at 8 and 12 weeks of age
   - rabies at 12 to 16 weeks of age
4. consider annual revaccinations, FeLV testing and vaccination, and any other program deemed appropriate for the situation.
5. population control is often necessary
   - spay and neuter program
   - elimination of excess cats

N. **Vaccination programs**
1. an absolute must for any facility containing multiple cats
2. general recommendations for vaccination of cats
   a. vaccinate all cats against FPV, FHV, and FCV
      - at 8-10 weeks of age
      - again at 12-plus weeks of age
      - revaccinations at 1-3 year intervals
   b. breeding catteries where respiratory disease is endemic
      - vaccination of kittens should begin at 4 weeks of age
      - repeat vaccinations at 8 and 12 weeks of age
      - revaccinate at 1-3 year intervals
   c. shelters or other facilities with rapid movement of cats into the facility

- use MLV vaccines for faster protection
- and therefore are preferred over inactivated vaccines.

3. rabies vaccine - for all cats that potentially can be exposed to wildlife, including all farm cats and all outdoors cats
4. Additionally, cats can be vaccinated for feline chlamydia and feline leukemia if the conditions warrant.

O. **Disinfection**

1. Proper daily disinfection of areas frequented by cats is essential
2. Each type of facility will vary in the amount and type of disinfection possible.
3. The type of disinfectant used should be selected carefully.
   a. Not all disinfectants that are sold as "virucidal disinfectants" will in fact inactivate or kill all viruses. FPV and FCV are particularly difficult to inactivate, while some viruses like FHV are easily inactivated by most any disinfectant.
   b. The most practical and effective disinfectant is ordinary household bleach (Clorox) diluted 1:32 in water (4 ounces per gallon of water). A cleaning solution or other disinfectant/soap preparation may be carefully added to the bleach solution just before use.
4. All food and water dishes should be washed and then soaked for 5-10 minutes in the bleach solution, then thoroughly rinsed in clear water, before reuse.
5. Litter pans should be cleaned and disinfected daily, or as often as practical.
   - Litter should be disposed of properly.
6. Cages, floors, or exposed walls should be disinfected daily.
7. Towels, rugs, and pads should be frequently washed in hot water.
8. In situations where adequate disinfection cannot be carried out routinely, the degree of control of infectious diseases will be compromised.

V. NOVEL AND MISCELLANEOUS FELINE INFECTIOUS DISEASES

A. Cat-scratch disease {8478, 8257, 8558}
   1. human infection from exposure to cats
   2. etiology = a pleomorphic gram-negative bacillus - classified as Rochalimaea henselae (originally thought to be *Afipia felis*)
   3. self-limiting disease in normal individuals, but can have severe consequences in immunocompromised individuals such as HIV-positive persons.
   4. CSD most often described as a "benign subacute regional lymphadenitis after cutaneous inoculation", or as a "chronic lymphadenopathy"
   5. Role of cat appears to be as a subclinical carrier of the organism, then a vehicle for cutaneous inoculation following a scratch or bite.
   6. Causative bacterium is susceptible to aminoglycoside antibiotics in vitro. Efficacy of in vivo antibiotic therapy has not been convincingly established.
   7. Over 40% of cats in San Francisco area are persistently bacteremic for *Rochalimaea helselae*
   8. Experimental inactivated vaccine for cats being tested - for public health benefits.
   9. Fleas may be involved in transmission of *Rochalimaea henselae* to humans from cats.

B. *Haemophilus felis* {8628, }
   1. New bacterium isolated from the lower respiratory tract of a cat with "chronic obstructive pulmonary disease".
   2. Positive isolations for the nasopharynx of 6 of 28 apparently normal cats.
   3. Sig. = 6-year-old cat presented to Virginia-Maryland VMTH
   4. History = 4-year history of "raucous" breathing described by the owner as "audible gurgling". Sneezing, coughing, and nasal discharge were absent.
   5. Exam:
      a. Increased airway noise = fluid-like sounds over nasal passages and trachea
      b. Chest radiographs = collapsed cranial lung lobe, dilated bronchi with calcification of bronchial wall.
      c. Thick, yellow exudate in endotracheal tube
   6. Therapy:
      a. Unresponsive to various antibiotics and to chlorpheniramine over 4 years.
      b. Clinical resolution with 1-month therapy of tetracycline.
   7. Reference: Inzana et al., J. Clinical Microbiology 30 (8):2108, 1992.

C. Canine distemper infection of large cats {}
   1. Outbreak of fatal encephalitides in lions and tigers in Germany, and in the Serengeti National Park in Tanzania. 75 fatal cases in Serengeti in lions
   2. Cause = canine distemper virus
   3. CDV infection of domestic cats is an abortive infection. At this time, no known hazard of this strain of CDV for domestic cats.

D. Feline poxvirus infection
   1. Outbreak of chronic skin disease or fatal respiratory disease in domestic and exotic cats has occurred in Europe.
   2. Not known to be present in U.S.
   3. Virus is identical or very similar to cowpox virus.
   4. Steroid and/hormone therapy for skin condition resulted in severe disease.
   5. Fatal human case in immunosuppressed person - infected from cat

E. Papillomavirus infection of cats - Two reports of identification of papillomavirus (wart virus) in cats.
   1. *Egberink et al., Vet. Microbiology, 31:117, 1992*
      - 6-year-old cat
      - multiple skin lesions = slightly raised, pigmented plaques
      - FIV positive
      - EM of lesions = many papillomavirus particles
      - immunohistochemistry showed antigenic reactivity with bovine papillomavirus
   2.. *Carney et al., J. Vet. Diagn. Invest. 2:294, 1990*
      - 2 unrelated adult (10 & 13 years) Persian cats - 10 years apart
      - both under long-term hormone or corticosteroid therapy for dermatology
      - sessile hyperkeratotic skin lesions (not typical papillomas)
      - FeLV and FIV negative
      - papillomavirus identified by EM
      - reactive with bovine papillomavirus, but is unique virus

F. Fibrosarcomas in cats following subcutaneous vaccination {8514,8674}
   1. *Hendrick et al., U. PA,*
      a. JAVMA 198:304-305, 1991
      b. JAVMA 199:968, 1991
      c. Cancer Res. 52:5391-5394,1992
      d. Vet. Pathol. 31:126-129, 1994
      - 1987-91 = 437 cases of fibrosarcomas at vaccination or injection sites (61% increase), comparedto 220 at non injection sites (no increase/year)
      - since 1990, high number of fibrosarcomas in the dermis and subcutis of dorsal portion of neck and interscapular regions
      - Gray-brown foreign material within cytoplasm of macrophages surrounding tumor shown to be aluminum oxide, consistent with adjuvant used in vaccines
      - appear to coincide with state requirement of vaccinate cats for rabies
   2. *Pathology service at Cornell University*
      - seeing 1-2 cases/week of skin and subcutis fibrosarcomas in cats as described above, including gray-brown foreign material within macrophages
   3. Types of tumors produced - of 46 cases (Hendrick & Brooks, 1994)
      a. fibrosarcomas (50%)
      b. malignant fibrous histiocytomas ()
      c. osteosarcomas ()

d. rhabdomyosarcomas ()
e. chondrosarcomas ()

G. Chronic migrating subcutaneous abscess
1. *Shin et al., Cornell Univ., 1992, unpublished information*
a. Case History = "Kato"
- adult cat >5 years of age
- chronic, recurring abscesses of ears and face
- 6/5/85 = abscess under metatarsal pad
- 7/27/85 = hot spot, left hip
- 11/2/88 = old bite wound & cellulitis
- 11/7/89 = swollen LF paw
- 10/31/90 = abscess, base of left ear
- 11/14/90 = abscess base of left ear worse
- 11/23/90 = new abscess below original ear abscess
- 1/14/91 = face swollen under right eye
- 1/22/91 = abscess on right side of face
- 1/24/91 = swelling at venipuncture sites, both front legs
- 1/25/91 = switched antibiotic to tetracycline, 100mg TID
- 2/11/91 = doing very well, abscesses healing
- 7/91 = abscesses all healed
- unresponsive to various antibiotic therapies until tetracycline used
- culture "negative" by routine bacteriology
- negative for FeLV, FIV, haemobartonella,
- isolation of novel organism made by special culture techniques

b. Experimental infection
- experimental subcutaneous inoculation of 4 cats with cultured organism reproduced multiple abscesses from which original organism was isolated
- hematology - representative experimental case

- Cells	Count/ul	Normal/ul
- Total WBC	30,600	(6,100-21,100)
- Bands	0	(0-0)
- Segs	25,100	(2,600-13,600)
- Lymphocytes	3,700	(1,300-9,100)
- Monocytes	1,200	(0-700)
- Eosinophils	600	(200-4,300)
- Basophils	0	(0-200)

c. Etiology
- to be discussed

d. Need for further research
- have you seen similar cases in your practice?
- please contact Dr. Sang Shin, Diagnostic Laboratory, College of Vet. Med., Cornell University, Ithaca, NY 14853 - (607)-253-3900 He would like to

receive material from similar abscesses for culture, with complete history.

2. *Carro et al., JAVMA 194:1583-, 1989*
   - isolated L-forms of mycoplasma as a cause of abscesses in cat
   - unresponsive to modern antibiotics, but did respond to tetracycline

H. Lyme disease in cats
1. *Burgess, AJVR 53:1507, 1992*
   - experimental infection of cats with *Borrelia burgdorferi*
   - all IV, orally, and ocularly inoculated cats seroconverted to Borrelia
   - no clinical signs produced
   - spirochetes detected in blood smears up to 24 days after inoculation
2. *Baldwin, Cats Magazine 48:22, 1991*
   - claims to have treated 150 cats afflicted with Lyme disease, now diagnosing it daily year around, in his practice near Lyme, CT
   - depressed, fever, inappetence, pain in back, jaw, joints, tail pain
   - 2 of 3 cases have positive Lyme disease antibody titers
   - response to antibiotic therapy is good

I. Contagious Streptococcal Lymphadenitis in cats
1. References
   a. *Goldman & Moore. Spontaneous Lancefield group G streptococcal infection in a random source cat colony. Lab. Anim. Sci. 23:565-566, 1973.*
   b. *Swindle et al. Contagious streptococcal lymphadenitis in cats. J. Amer. Vet. Med. Assoc. 177:829-830, 1980.*
2. Clinical disease
   a. acute lymphadenitis of the lymph nodes of the head and neck
      - purulent lymphadenitis
      - mandibular, parotid, and medial retropharyngeal lymph nodes
      - open draining abscesses at angle of mandible
   b. fever
   c. inappetance
   d. listless and weak
   e. outbreaks in laboratory cats
   f. sporadic cases in pet cats
3. Etiology
   a. Lancefield group G beta-hemolytic streptococcus
      - consistently isolated from affected lymph nodes
      - will cause the disease in experimental cats inoculated by the oral or subcutaneous routes
   b. group G streptococci commonly found on mucous membranes of cat

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