

VETERINARY MEDICAL REVIEW

Respiratory Parasites

Special
Insert—
Faculty Directory

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College of Veterinary Medicine and
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Respiratory Parasites of Small Companion Animals

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The dog and cat are often infected by parasites that reproduce in the air passages and pulmonary parenchyma. These parasitic infections must be differentiated from parasites whose larval forms only migrate through the respiratory system and parasites that migrate aberrantly into the respiratory system. A wide variety of clinical signs and pathologic lesions develop from primary parasitic infection of the respiratory tract.

The severity of clinical manifestations is quite variable; from asymptomatic to fatal infections. This broad range of clinical syndromes depends largely on the number of organisms that infect the respiratory tract, the site of predilection within the respiratory system by a particular parasite, and the nature of the host's response to the presence of the parasite. Clinical cases in domestic small companion animals occur infrequently, but the author has seen numerous cases in both dogs and cats and suspects that undetected infections are widespread.

Four respiratory parasites are of clinical and practical importance in the dog and cat (Table 1). Other primary parasitic infections of the respiratory system occur but are considered very uncommon and sporadic in nature (Table 2). Individual clinical entities are best discussed in terms of the causative organism. An understanding of the biology of each parasite is necessary to develop a rational approach to treatment and control of each organism.

Filaroides osleri

This nematode is a slender worm (up to 1 cm in length) that forms eosinophilic granulomatous nodules in the distal trachea, tracheal bifurcation and extending into the mainstem and lobar bronchi (Figure 1).

The life cycle of *F. osleri* is unknown and may not follow the pattern of other metastrongyles that require mollusks as intermediate hosts. The first stage larvae found in freshly-passed canine feces may be directly and immediately infective when ingested by a dog. Other species in this group of parasites involve snails and slugs as intermediate hosts and possibly rodents as transport hosts. This type of optional life cycle may also serve as a source of *F. osleri* infection to

dogs with natural predatory habits. After ingestion, the parasite is thought to penetrate the intestinal mucosa and migrate to the distal trachea and major bronchi where submucosal eosinophilic granulomas or nodules are formed.

Clinical cases occur in young dogs 6 months to 3 years of age and mimic infectious tracheobronchitis (kennel cough). The dog is usually presented with the chief complaint of a chronic paroxysmal, non-productive to slightly productive cough of several months duration. In the early stages of infections there are no systemic signs with the dog exhibiting a good appetite and normal exercise tolerance. Dyspnea, bouts of wheezing, anorexia and weight loss become progressively worse as the granulomas further occlude the mainstem bronchi. The clinical signs are often exacerbated during exercise or when the dog becomes excited. The coughing and wheezing are very unresponsive to all forms of symptomatic therapy including antibiotics, antihistamines and antitussives. Physical examination is often normal in early cases while inspiratory dyspnea and auscultation of crackles and wheezes are prevalent in advanced cases.

Diagnosis of *F. osleri* infections is accomplished with the aid of a complete blood count, thoracic radiographs, transtracheal washing and aspiration, fecal examination and tracheobronchoscopy. The hemogram may be normal but frequently exhibits a mild to moderate eosinophilia. Thoracic radiographs also may be normal while some cases reveal nonspecific signs of peribronchial infiltration, pleural thickening, and increased linear interstitial markings. The actual tracheobronchial nodules are very difficult to visualize without the aid of positive contrast bronchography.

Fecal examination should include a flotation and direct saline smear of fresh feces or sediment to look for larvae. If larvae are found in fresh feces which are not contaminated with soil or extraneous organic material, then one needs only distinguish between lungworm larvae of metastrongyloids (*Filaroides*, *Aelurostrongylus*, *Crenosoma*), and the rhabditiform larvae of *Strongyloides stercoralis*. If the feces are stale, then hookworm larvae may have developed and hatched. In fecal specimens contaminated with soil or extraneous organic material free-living nematodes and their larvae may

Table 1. Common Respiratory Parasites

Canine

Filaroides osleri
Capillaria aerophila
Paragonimus kellicotti

Feline

Aelurostrongylus abstrusus
Capillaria aerophila
Paragonimus kellicotti

also confuse the issue by their presence. Larvae of *F. osleri* average 230 μ in length and have a characteristically kinked tail. Larval numbers are often small and multiple negative fecal examinations does not rule out a respiratory parasitic infection.

Transtracheal washing and aspiration is a valuable technique in the diagnosis of all respiratory parasitic infections. Cytologic examination of the material obtained by transtracheal washing will reveal characteristic embryonated eggs of *F. osleri* (Figure 2). A final method of diagnosis and evaluation of *F. osleri* infection is tracheobronchoscopy. This procedure involves using a rigid or flexible bronchoscope to visually evaluate the trachea and carina. Examination will reveal numerous 1-10mm nodules protruding into the distal tracheal lumen and occluding the mainstem bronchi. Endoscopy serves as both a diagnostic tool and a method to evaluate the severity of the lesions. Along with clinical response, periodic endoscopic examination during therapy also serves as a means to assess improvement.

Many modes of therapy have been utilized for *F. osleri* infections. Methods of treatment have included surgical removal of nodules, diethylcarbamazine citrate, intravenous thiacetarsamide, phenothiazine, tetrachlorethylene, stibophen, cyanacetyldiazide, intratracheal injection of phenol or phenothiazine, and lithium antimony thioanilate. The most successful mode of therapy reported is long-term use of the oral anthelmintic compounds thiabendazole^a or levamisole^b. Thiabendazole (TBZ) has reported to be successful at dosages of 60-140 mg/kg divided twice daily in food for 10-30 days. Because high initial dosages are poorly tolerated with severe emesis, TBZ must be introduced gradually. Levamisole is used at an oral dosage of 7-12 mg/kg daily for at least 20-30 days. Side effects from levamisole include vomiting, salivation, diarrhea and restless behavior. Therapy with both TBZ and levamisole should continue until remission of all clinical signs and/or a decrease in the quantity and size of the nodular lesions as reviewed by

^aThiabendazole^R, Merck Animal Health Div., Rahway, New Jersey.

^bTramisol, Cyanamid Agricultural de Puerto Rico, Manati, Puerto Rico.

Table 2. Respiratory Parasites of Lesser Concern

Filaroides milksi
Filaroides hirthei
Crenosoma vulpis
Pneumonyssus caninum
Linguatula serrata
Spirocerca lupi
Toxoplasma gondii

tracheobronchoscopy. In the author's experience both thiabendazole and levamisole have been used successfully to treat *F. osleri* infections but required several months of treatment. It remains to be seen if newer compounds such as albendazole and fenbendazole can be used successfully.

Aelurostrongylus abstrusus

The domestic cat is the only known definitive host for this parasite which has worldwide distribution. The adult worms reside in the respiratory bronchiole, alveolar ducts, alveoli and occasionally in the smaller branches of the pulmonary arteries. Eggs are laid by the adults in the alveoli, alveolar ducts and interstitial spaces. The eggs embryonate to first stage larvae (L₁) which ascend the respiratory tree and are coughed up, swallowed and deposited in the feces. The L₁ can survive several weeks to months in moist soil but require a molluscan intermediate host, such as snails or slugs, for further development. The cat is infected by ingesting the snail or slug containing the infective third stage larvae (L₃). The natural mode of infection is probably through predation of paratenic or transport hosts. The transport hosts (amphibians, birds, reptiles, rodents) may eat the infected mollusks, and the L₃ merely reencysts in their tissues and undergoes no further development. The L₃ are thus found unchanged and alive in tissues of the transport hosts to serve as a source of infection to the feline predator. When ingested, the L₃ penetrates the gastrointestinal mucosa and follows a blood migration to the lungs.

The clinical signs of aelurostrongylosis in the cat depends to a great deal on the number of parasites involved and the response of the individual cat to the adults and ova. The presence of adults and ova stimulate an intense granulomatous inflammatory response in both the alveolar and interstitial portions of the pulmonary parenchyma. Many affected cats show little or no clinical disturbance. In one study, 27% of the cats found to be positive for *Aelurostrongylus* larvae had no clinical respiratory signs. Thus, in a certain percentage of cats the disease is probably asymptomatic and self limiting.

Typical signs of clinical aelurostrongylosis include a chronic harsh non-productive cough, dyspnea,

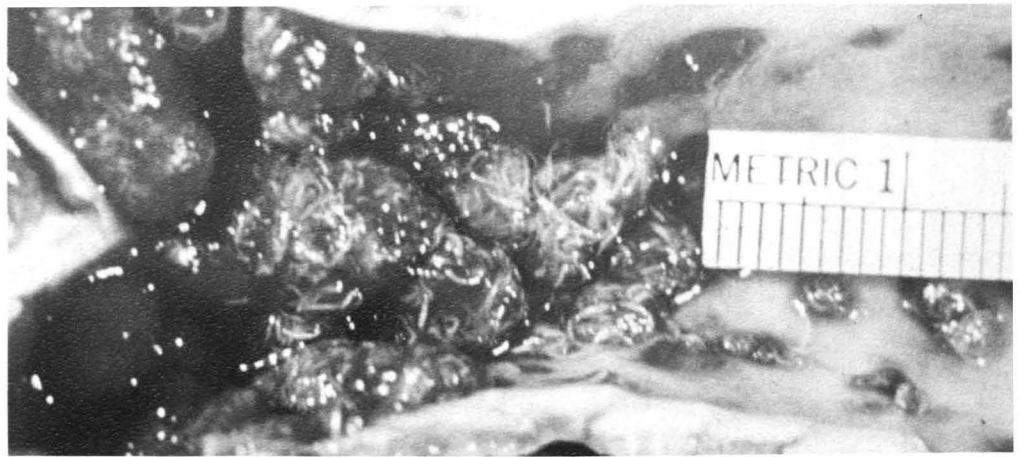


Figure 1. Gross pathological specimen of a dog infected with *F. osleri*, revealing numerous granulomatous nodules in the distal trachea and main stem bronchi. Note the slender nematodes in each nodule.

tachypnea, anorexia, fever and lethargy. These signs may be quite progressive and severe. The most dangerous period is 6-13 weeks after infection when great numbers of eggs and larvae are deposited in the pulmonary parenchyma. Auscultation during clinical disease will reveal diffuse low-pitch crackles and wheezes.

Aelurostrongylosis may be diagnosed on the basis of history, physical examination, hematology, thoracic radiographs, transtracheal washing and fecal examination. The most commonly infected cat is one which is an outdoor predator with the previously described signs. Leucocytosis and eosinophilia are the most common hematologic findings.

The radiographic findings in experimental aelurostrongylosis have been well described. The earliest radiographic sign of lung disease in the infected cats was a mixed pattern with bronchial and patchy alveolar signs. During the most severe stages of experimental disease, an alveolar pattern was predominate. As the alveolar pattern subsequently resolved, the nodular interstitial and peribronchial pattern became more obvious. Thus it can be seen that aelurostrongylosis can cause the entire gamut of radiographic pulmonary patterns in the cat.

Identification of the characteristic notched or S-shaped tail first stage larvae (L₁) is the most accurate and practical method in the living patient. The L₁ can easily be identified in exudate obtained by transtracheal aspiration or tracheobronchoscopy. The L₁ can also be identified in direct smears and flotation of fresh feces. Fecal examination and transtracheal washings will not reveal early infections when adults are not yet mature nor late infections when worms are no longer laying eggs.

Treatment of asymptomatic individuals may not be necessary. Periodic examination of feces and careful observation for signs of clinical disease may suffice in these patients. Severely affected cats require supportive treatment for the dehydration and emaciation that

often accompanies the chronically ill individual. Aside from isolated case reports there is very little information concerning suitable anthelmintic therapy. Little or no success has been reported from the use of antimony biscatechol disulfonate, organic arsenicals, intravenous sodium iodide, diethylcarbazine citrate, emetine hydrochloride, dihydrostreptomycin, sulfonamides, methyridium and dithiazinone iodide. The most effective reported anthelmintic is levamisole. It should be used with precaution since levamisole is poorly tolerated by cats. A dosage of 25-45 mg/kg orally every other day for 5-7 treatments has reported to be effective. Newer compounds such as albendazole, which is probably safer in the feline, should be tried in the treatment of aelurostrongylosis.

Capillaria aerophila

The "fox lungworm" is a slender (15-40mm in length) parasite that infects the trachea and bronchi of wild carnivores and sometimes the domestic dog and cat. *C. aerophila* is not a metastrongyle, but it is a member of the *Tricuroidea* and thus is closely related to whipworms.

The adult parasites inhabit the mucosal and deeper structures of the tracheobronchial tree. Eggs are laid on the mucosal surface and are coughed up, swallowed and pass as an intact ovum in the feces. The eggs are very resistant to environmental conditions and require 5-7 weeks to mature. Infection occurs by ingestion of the infective egg (direct life cycle) or may involve earthworms as facultative intermediate hosts. The eggs hatch and larvae penetrate the gastrointestinal mucosa on a migration to the lungs via the blood.

Capillariasis may be an asymptomatic and self-limiting infection. Several canines have been seen by the author which were positive for ova but free of clinical signs. Clinical disease usually occurs in young dogs and cats. A kitten as young as 10-weeks of age has been

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Parasites, cont.

reported to be infected with clinical signs. Most dogs and cats exhibit a chronic mild to moderate, non-productive to productive cough and occasional periods of dyspnea, respiratory distress, anorexia and weight loss. In both dogs and cats the cough is usually very intermittent with periods of acute exacerbation. Physical examination may vary from normal to occasional crackles on auscultation. A cough is easily elicited upon tracheal palpation due to the

tracheitis and bronchitis.

Diagnosis of capillariasis involves history, physical examination, hematology, thoracic radiographs, transtracheal washing, endoscopy and fecal examination. Mild leucocytosis or eosinophilia have been consistent hematologic findings. Characteristic changes in the thoracic radiographs are not reported. In the author's experience, most infected patients will show a mild increased linear interstitial pattern with occasional peribronchial markings on thoracic radiographs. Demonstration of the characteristic oval, pale-yellow, unembryonated eggs (35 x 60u) with bipolar plugs in fecal floatations or tracheobronchial washings (Figure 2) is the best method of diagnosis. Tracheobronchoscopy will reveal an increased amount of serous to mucoid exudate and inflamed tracheobronchial mucosa.

Few reports of successful treatment of capillariasis are found in the literature. Treatment with levamisole in both cats and dogs has proved successful in isolated case reports. However, one report found that parenteral levamisole at 8 mg/kg daily did not alter the fecal egg output of *C. aerophila* in two cats. The author has used albendazole^c at a dosage of 25 mg/kg twice daily orally for five days with good success in one dog and two cats. Further treatment regimes need to be studied in a greater number of clinical cases. Because of the mild clinical course of most patients, the prognosis for full recovery is good.

Paragonimus kellicotti

P. kellicotti is a digenic fluke that forms fibrous cysts in the lungs of many different wild carnivores and domestic dogs and cats. The parasite is widely distributed in the United States and portions of Canada, and as far as can be ascertained it is the only species of *Paragonimus* in North America. The distribution of *P. kellicotti* is regulated by the distribution of its intermediate hosts.

The life cycle of this trematode involves two intermediate hosts. Eggs passed in the feces of carnivores develop into miracidia which infect the first intermediate host, small aquatic snails. The miracidia multiply asexually in the snail and produce mature cercariae. These cercariae leave the snail and penetrate the second intermediate host, the crayfish, and become metacercariae in the crayfish heart. Carnivores, dogs, and cats become infected by ingesting crayfish with metacercariae.

Young flukes encyst in the intestines, migrate through the peritoneal cavity, diaphragm and pleural cavity where

they penetrate the pulmonary parenchyma. Here they form cystic cavities in the parenchyma that establish communication with bronchioles. Eggs are produced which enter these bronchioles to be coughed up and swallowed. The prepatent period is 34-56 days. The risk of natural infection in dogs and cats that are predators might be quite high when one considers that in a local watershed near Columbus, Ohio, 42-80% of crayfish were documented to be infected with *P. kellicotti* metacercariae.

Clinical signs again vary with the number of parasites infecting the host and the hosts reaction to the presence of adults and ova. Experimentally inoculated cats have been clinically normal despite radiographic evidence of lesions. This may also occur in natural infection. Typical clinical signs of pulmonary paragonimiasis include a chronic productive cough, respiratory distress, acute dyspnea associated with spontaneous pneumothorax, hemoptysis, excessive salivation, and systemic signs such as anorexia, lethargy and weight loss. The pathologic features of pulmonary paragonimiasis that produce clinical signs consist of parasitic cysts or cavities and an intense eosinophilic inflammatory response to both adults and ova. Pneumothorax occurs frequently and is associated with communication of a parasitic cyst with the pleural space.

Diagnosis of pulmonary paragonimiasis is based on environmental history, physical examination, hematologic studies, radiographic findings, fecal examination and transtracheal washing. The environmental history usually relates to an animal that is an active predator with access to streams or lakes where the infected second intermediate host, the crayfish, is located. Physical examination often reveals an unthrifty animal which is easily induced to cough with or without hemoptysis. Auscultation will vary with the severity of the infection. Mild neutrophilic leucocytosis with a left shift, and eosinophilia are usual hematologic findings.

The radiographic features of pulmonary paragonimiasis in the dog and cat have been well documented. The lesions are most often detected in the caudal lung lobes which probably reflects the migration pathway of the fluke. Ill-defined interstitial nodular densities and distinct multi-loculated air-filled

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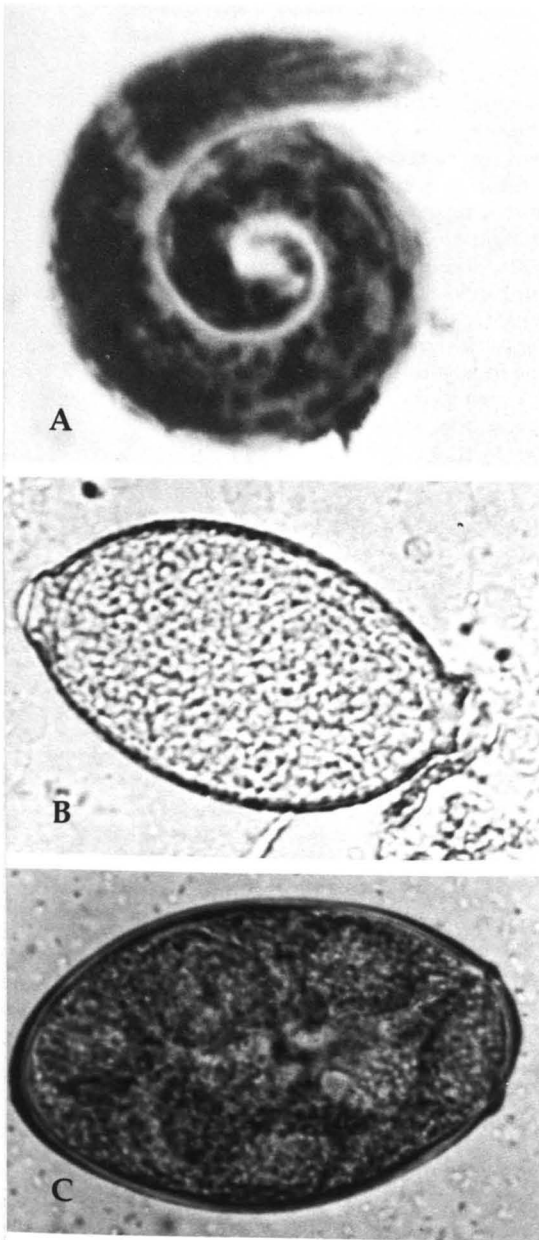


Figure 2. Respiratory parasite ova obtained via transtracheal washing and aspiration. (A) Embryonated ova of *F. osleri*. (B) Oval unembryonated egg with bipolar plugs characteristic of *C. aerophila*. (C) Single operculated ova of *P. kellicotti*.

^cValbazen[®], Smith Kline Animal Health Products, West Chester, Pennsylvania.

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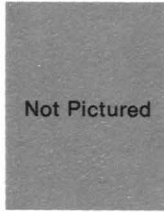
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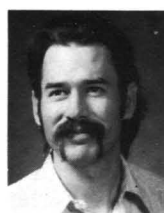
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- A. A. Toomey, Resident, Veterinary Medicine and Surgery - B.S., D.V.M., MSU.
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- M. E. Tumbleson, Associate Professor, Veterinary Anatomy-Physiology, and Research Associate, Sinclair Farm - B.S., M.S., Ph.D., MIN.
- D. Vaillancourt, Research Associate, Veterinary Medicine and Surgery - D.V.M., MON.
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- G. M. Zinn, Assistant Professor, Veterinary Medicine and Surgery - D.V.M., ISU; Ph.D., MO.

*Note: Abbreviations for Colleges of Veterinary Medicine in this Directory follow the abbreviations used in the AVMA Directory. Those colleges and universities denoted with an asterisk are not listed in the Key to Abbreviations for Colleges of Veterinary Medicine in the AVMA Directory.



College Holds Telefund

On the evenings of November 6 and 7, 1979, 37 volunteer students of the College made over 700 telephone calls to solicit pledges from College alumni. Over \$2,800 was pledged by 92 alumni; another 48 pledged indefinite amounts. Most of the pledges came from alumni residing in Missouri, although a hefty amount, more than \$1,000, was raised from 28 out-of-state alumni.

The College plans to utilize dollars donated during this Telefund for several improvement projects around the College, including upgrading the Large Animal receiving and treatment area. Everyone at the College sincerely thanks all who gave in this effort.



Dr. Bierschwal Honored

Dr. Clarence Bierschwal (right) was named Outstanding State Specialist by the Missouri Beef Cattle Improvement Association during their annual meeting at the University of Missouri-Columbia, November 2. Wayne Atkins (left), Assistant to the Vice President for Extension, presented the plaque.

Dr. Bierschwal is a Diplomate of the American College of Theriogenology, and he has been on the College's faculty since 1951. Dr. Bierschwal has appeared frequently before producer groups to discuss beef production. He has assisted with production-tested bull sales held by the Improvement Association.

Avian Pathologist Appointed

Dr. Darrel W. Trampel was recently appointed Assistant Professor at the College. Dr. Trampel's specialty is avian pathology, and he works with Dr. E. L. McCune at the College's Veterinary Medical Diagnostic Laboratory.



Dr. Trampel received his DVM degree with honors from Iowa State University in 1974. Following two years of private practice, he entered the graduate program at the University of Georgia at Athens. Dr. Trampel received the PhD degree in 1979, specializing in veterinary pathology.



Two-Headed Calf

No, this is not a trick picture. This is a straight-forward photograph of the joined skulls of a two-headed calf. The skulls were prepared by Mr. John Morrison, preparator for the College's gross anatomy laboratory.

During preparation, the skulls disarticulated along the suture lines. This permitted Mr. Morrison to observe the brains of the animal, which were separate down to a common brain stem. Mr. Morrison painstakingly reassembled all of the pieces into a display mount. He worked on this project between regular duties over a two-month period.

Mr. Morrison's other work includes preparation of whole-animal specimens for first-year students.

Faculty Member Joins Jefferson Club

Dr. Harlan E. Jensen, Professor at the College, has become the fourth member of the Veterinary Medicine Chapter of the Jefferson Club.

Dr. Jensen has pledged to the College his valuable collection of one-of-a-kind, stereo, color transparencies relating to veterinary ophthalmology.



Dr. Jensen is a Diplomate of the American College of Veterinary Ophthalmology and is appointed to the Department of Veterinary Medicine and Surgery. He received his DVM from Iowa State University and his PhD from the University of Missouri-Columbia.

The Jefferson Club is the way in which the University's Alumni Association recognizes those who donate to the University \$10,000 or more in money or personal property, or who bequest in their wills \$20,000 or more. If a donor wishes the contribution to go to the College, that donor may request to belong to the Veterinary Medicine Chapter.

Faculty Publish

Drs. A. A. Bickford, C. J. Bierschwal, H. E. Garner, L. D. Kintner, and C. E. Martin are contributors to the Fifth (1979) Edition of the Merck Veterinary Manual.

Taylor, J.L., Wagner, J.E., Kusewitt, D.F., and Mann, P.C.: "Klossiella Parasites of Animals: A Literature Review", *Vet Parasit*, 5 (1979):137-144.

Protocol—Culture of Horses for Contagious Equine Metritis

Veterinary Practitioners Should Watch for Infected Horses This Coming Breeding Season

R. S. Youngquist, DVM, Dept. Veterinary Medicine & Surgery, W. H. Fales, PhD, Veterinary Medical Diagnostic Laboratory

Editor's note: Contagious equine metritis (CEM) is an acute venereal disease of horses that was diagnosed in several horses in Boone County, Missouri, this past breeding season. On April 18, 1979, a private practitioner made a tentative diagnosis of CEM on one farm. He immediately contacted the Veterinary Medical Diagnostic Laboratory at the College. Additional samples were taken by College personnel, and the State Veterinarian's Office was notified. Samples were simultaneously cultured for the CEM organism at the College and

at the National Veterinary Services Laboratory in Ames, Iowa. On April 20, reacting to initial suspicions regarding what the College had reported, the Missouri Department of Agriculture began quarantine action on suspect farms. Because CEM was detected early in the breeding season and because prompt confirmation was made of the outbreak, a federally-imposed state-wide quarantine was avoided, thus saving Missouri an estimated \$10 million in 1979.

Although catastrophe was narrowly averted last year, regulatory officials remain concerned that CEM may appear again in Missouri (or in another state). The following protocol is published in the hope that all veterinary practitioners will be "on the lookout" and then, if anyone suspects the presence of the disease, correct diagnosis may be quickly made.

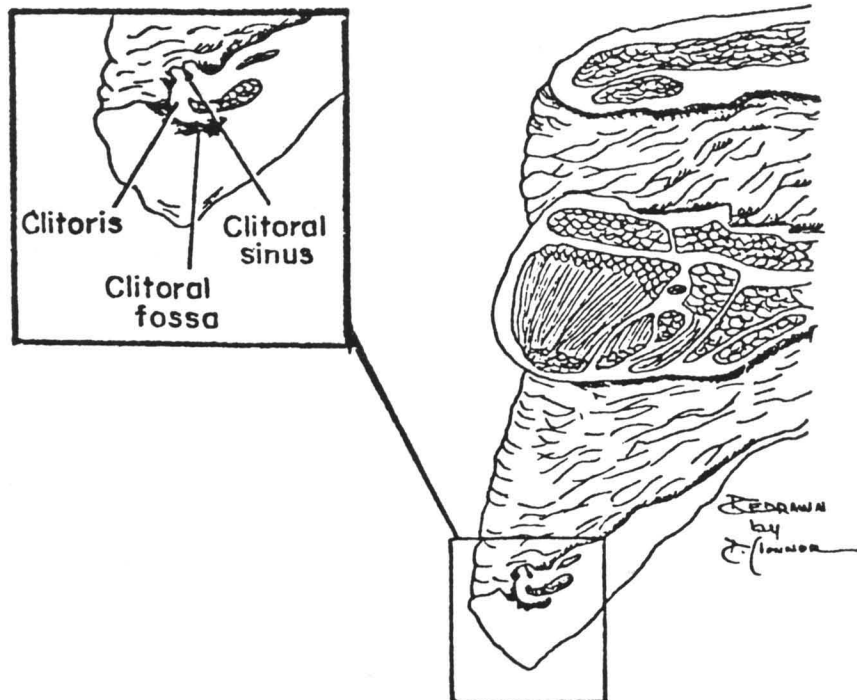


FIGURE 1. Diagram of equine external genitalia demonstrating areas to swab for culture for CEM.

I. Clinical Signs—

A. Mare—Clinical signs are variable and may include any of the following:

Copious vaginal discharge two to ten days after service, and premature return to estrus due to lysis of the corpus luteum, and infertility. There are no reports to date of systemic involvement.

B. Stallion - The stallion is considered to be contaminated rather than infected and serves only as a mechanical transmitter of the disease. To date, no clinical signs have been described in contaminated stallions.

II. History - A complete reproductive history of the suspect animal should be obtained and must be submitted along with samples to the laboratory.

III. Samples for Culture - When CEM is suspected, special attention must be given to obtaining suitable samples from the proper sites for diagnosis. Routine aerobic culture methods will not allow demonstration of the organism.

A. Mare - At present, it is recommended that samples be obtained from the following sites in mares suspected of having CEM:

1. Clitoral fossa - The clitoris is everted by manual pressure on the vulvar lips and the clitoral fossa swabbed (Figure 1).

2. Clitoral sinus - Within the clitoris is a small sinus which is the homologue of the urethral sinus in the male. The sinus may have a variable number of openings ranging from one to five. A small swab is necessary to enter the sinus. Access can be gained to the sinus opening by everting the clitoris and observing the small orifice (s) on the dorso-cranial aspect of the clitoris (Figure 1). The clitoral sinus is not widely described in standard anatomy textbooks. Some mares have been encountered that object to swabbing of the clitoral sinus. After swabs are obtained from the clitoral fossa and sinus, the vulva and perineum are washed using a solution of chlorhexidine disinfectant.

3. Uterus or cervix - In non-pregnant mares a swab may be taken from the end metrium using standard large animal guarded swabs (Modified Teigland Swabs). In mares which may be pregnant, a cervical swab may be taken. Uterine or cervical

swabs may be taken through a disposable speculum or manually using a sterile disposable sleeve and glove. B. Stallion - Samples for culture of stallions are to be taken from the following sites:

1. Urethral fossa and sinus. The urethral fossa is located dorsal to the external urethral orifice.
2. Urethra - A swab is passed into the urethra and the sample taken.
3. Prepuce - Dried smegma should be wiped from the prepuce with sterile gauze and the preputial inguement swabbed.
4. Pre-ejaculatory fluid - The stallion should be teased sufficiently to stimulate the secretion of pre-ejaculatory fluid and the fluid swabbed as it drips from the urethra or caught in a sterile disposable container and then swabbed.
5. Test Mares - The isolation of CEMO from stallions is difficult due to contaminating organisms. When CEM is suspected, the stallion in question should be test mated to two known clean mares and the mares cultured for the organism.

IV. Labeling of samples - Sample tubes are to be labeled with the date, name of animal and site from which the sample was taken.

V. Sanitation - *Strict attention must be given to sanitation when dealing with horses suspected of having CEM.* The organism is readily transmitted from animal to animal on instruments, and on the hands and clothing of the examiner and assistants. Everything that touches the rear quarters of the mare or the penis and underline of the stallion must be sterile and disposable. A separate disposable tail wrap must be used for each mare. The assistant holding the tail should wear disposable shoulder length gloves and change between each mare. The examiner should wear a gown which may be changed between each mare examined and several layers of disposable shoulder length gloves which are removed in sequence after obtaining each sample. Since a separate bucket for each mare is not likely to be possible, a plastic bag is to be placed in the bucket containing the disinfectant and changed between each mare. All material used should be disposed of properly by incineration or autoclaving prior to disposal. Extreme mea-

asures must be taken in the area of sanitation to prevent spread from animal to animal and from farm to farm. All material used on an infected farm should remain on the farm.

VI. Transport of the Samples - Because of the growth requirements and fastidious nature of the CEM organism, swabs must be placed in Amie's transport medium immediately after they are taken. Transport media may be obtained by making prior arrangements with the diagnostic laboratory. Samples are to be taken immediately to the laboratory and should arrive within four hours. If transport time will exceed four hours, the samples are to be refrigerated and delivered to the laboratory within 24 hours. Prior

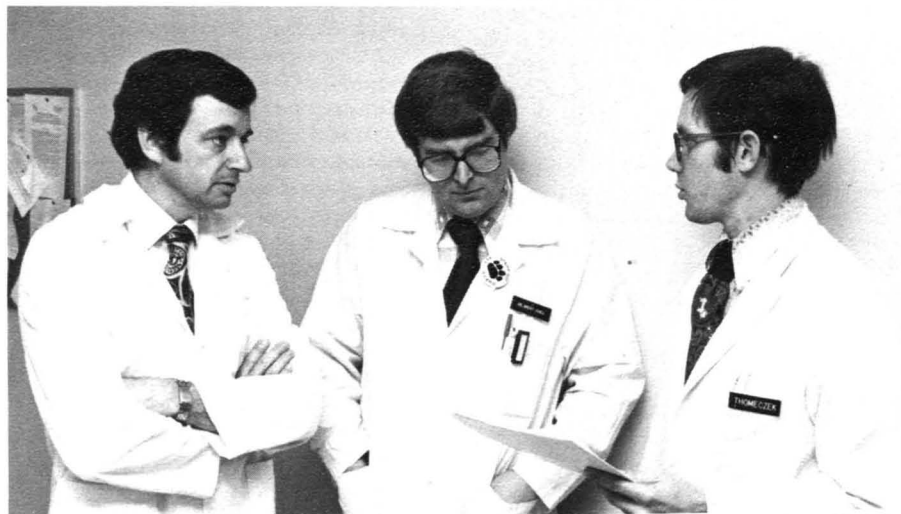
arrangements with the laboratory are required before submission of samples.

VII. Suggested Reading -

A. Hughes, J.P.: Contagious equine metritis: A review. *Theriogenology* 11:209 (March 1979).

B. Kester, W.O.: Special report: Contagious equine metritis and ban on horse imports. *American Association of Equine Practitioners Newsletter*, September 1, 1977.

VIII. Assistance - Please feel free to contact the College for technical assistance. Veterinary Medical Diagnostic Laboratory Microbiology Section: 314-882-6695 Department of Veterinary Medicine and Surgery Theriogenology Section: 314-882-6858



Dr. Peter Theran (left) discusses a diagnosis with Dr. Brent Jones (center) and VMIV student, Frank Thomeczek (right).

CE Endoscopy Course Unique

Ten veterinarians from such diverse places as Boston, Houston, and Calgary (Canada) came to Columbia for a two-day Continuing Education Workshop on endoscopy procedures, held December 7-8, 1979.

Among those who came was Dr. Peter Theran from the Angell Memorial Hospital in Boston. Dr. Theran is a noted specialist in feline endocrinology.

This workshop attracted veterinarians from around the continent because very few opportunities are available for training in endoscopy. Endoscopy has already opened doors to improved diagnostic and therapeutic procedures that are

more time-efficient and safer for the patient than older methods. One of the instructors for the workshop, Dr. Brent Jones, did pioneering work with endoscopy while he was a resident at the Animal Medical Center in New York. Dr. Jones is now an Assistant Professor with the College. Drs. Philip Roudebush and James Noxon assisted Dr. Jones in teaching the course.

Included in the workshop was a wet lab in which participants performed several endoscopy procedures with a range of instrumentation, from the sophisticated to the very economical. The College and the UMC Extension Division sponsored the workshop.

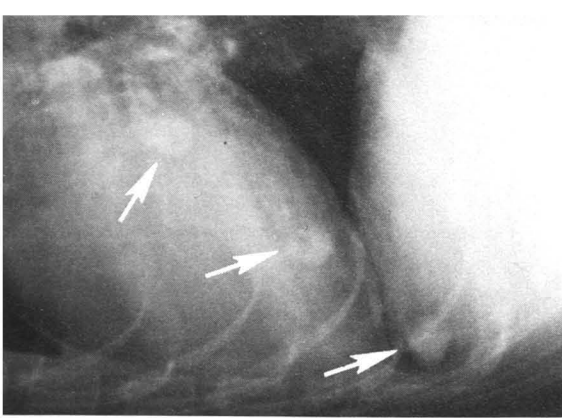


Figure 3. Lateral view of thoracic radiograph from a dog infected with *P. kellicotti*. Note the characteristic distinct nodular, air-filled pneumatocysts that are the most common findings in infected dogs (arrows).

Parasites, cont.

pneumatocysts are the most consistent radiographic findings in the lungs of infected animals (Figure 3). Radiographically, the interstitial nodular densities are more common in cats while pneumatocyst formation is the rule in dogs. Once the pneumatocyst forms around an adult fluke, there is little change in the radiographic appearance of the lesions even over a period of several months. Pneumatocysts may be confused on radiographs with bronchial cysts, pulmonary abscesses or cavitation neoplasms. Pneumothorax with pulmonary atelectasis is also a radiographic finding.

Diagnosis is best confirmed by finding the presence of the characteristic *P. kellicotti* eggs which are single operculated, measure 50 x 100u, and are gold-brown in color (Figure 2). The eggs are easily demonstrated on fecal examination or transtracheal aspiration of tracheo-bronchial secretions. The sedimentation technique of fecal examination is more sensitive in detection of *Paragonimus* ova at low counts than is sodium nitrate flotation. However, at peak egg production there is no apparent difference in diagnostic efficacy between sedimentation and flotation techniques.

Treatment of pulmonary paragonimiasis in the past has been difficult because of the inavailability of effective drugs in this country. Bithionol acetate has been shown to be effective in the treatment of *Paragonimus* infections in man and dog, but it is not licensed for use in the United States and is usually difficult to obtain. Dosages of bithionol reported to be efficacious are 500 mg/kg orally for 7 days or 100 mg/kg every other day over a 30-day period. Two new anthelmintic compounds, albendazole and fenbendazole^d, offer exciting possibilities for the treatment of pulmonary paragonimiasis. Albendazole in cats and fenbendazole in dogs have shown excellent results in the treatment of experimentally-induced infections. Pneumothorax from the migration of irritated or dying flukes is the only reported complication due to treatment with albendazole. For both drugs, dose rates vary because little definitive information is available. With albendazole, a dosage of 25 mg/kg twice daily for 5-10 days of an oral 20% drench solution is recommended. Treatment should be continued until at least two days of negative fecals have been observed. Fenbendazole at a dosage of 50 mg/kg orally twice daily for 3 days or 25 mg/kg orally twice daily for 8 days was effective in reducing egg production and caused regression of lesions. Both drugs are not currently licensed for use in the U.S. but should be available in the near future. The author has used albendazole on one canine case with excellent results and no side effects of complications.

Summary

It can be seen that infection with respiratory parasites needs to be considered in any small companion animal with the clinical signs of chronic coughing, acute dyspnea, wheezing, anorexia, weight loss, emaciation and hemoptysis. Many infections are asymptomatic and

^dPanacur, Hoechst AG Frankfurt, Federal Republic of Germany.

self-limiting while others are potentially serious unless treated appropriately. The astute clinician can easily diagnose these respiratory parasitic infections with the aid of a complete medical and environmental history, physical examination, hemogram, thoracic radiographs, fecal examination, transtracheal washing, and occasionally endoscopy.

Additional Reading/References

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Veterinary Medical Review

College of Veterinary Medicine
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