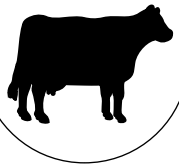

Otitis media in dairy calves: A retrospective study of 15 cases (1987 to 2002)

David Francoz, Gilles Fecteau, André Desrochers, Madeleine Fortin

Abstract — Epidemiological data, clinical signs, complementary examination findings, antimicrobial treatments, and outcome were reviewed in 15 calves diagnosed with otitis media at the Centre hospitalier universitaire vétérinaire de l'Université de Montréal between 1987 and 2002. Age at presentation ranged from 2 to 18 weeks. A purulent ear discharge and epiphora were seen in 8/12 and 6/15 cases, respectively. Neurological signs observed were head tilt (13), eyelid ptosis (7), paresis/paralysis of the pinna (8), ataxia (2), strabismus (2), and convulsions (1). Concurrent pneumonia was frequently diagnosed (n = 11). A *Mycoplasma* sp. was the principal pathogen isolated from ear discharge; 6 out of 6 samples submitted were positive for mycoplasma. Tympanic bullae radiographs were considered abnormal in 12 out of 13 cases. Cerebrospinal fluid analysis was considered abnormal in 2 out of 5 cases. The antibiotic most commonly used was enrofloxacin (n = 7). Average treatment duration was 19.6 days. Four out of 8 treated animals for which follow-up information was available completely recovered. These results suggest that *M. bovis* is a major pathogen of otitis media in dairy calves and effective antimicrobial therapy should be of long duration.

Résumé — Otite moyenne chez les veaux laitiers : étude rétrospective de 15 cas (1987 à 2002). Les données épidémiologiques, les signes cliniques, les examens complémentaires, les traitements et l'évolution ont été révisés chez 15 jeunes bovins laitiers atteints d'otite moyenne présentés au CHUV de l'Université de Montréal entre 1987 et 2002. L'âge lors de la présentation variait de 2 à 18 semaines. Un écoulement purulent de l'oreille et de l'épiphora ont été observés dans 8/12 et 6/15 des cas respectivement. Les signes neurologiques notés étaient : port de tête anormal (13), ptose (7), parésie/paralysie de l'oreille (8), ataxie (2), strabisme (2) et convulsions (1). Une pneumonie concomitante était souvent observée (n = 11). *Mycoplasma* sp. était l'agent le plus souvent isolé à partir des écoulements de l'oreille. Les radiographies de la bulle tympanique étaient anormales dans 12 des 13 cas. L'analyse du liquide céphalo-rachidien était anormal dans 2 cas sur 5. L'antibiotique le plus souvent utilisé était l'enrofloxacin (n = 7). La durée moyenne du traitement était de 19,6 jours. Quatre des 8 animaux traités pour lesquels le suivi a été possible ont récupéré à 100 %. Nous concluons que *Mycoplasma bovis* est un agent pathogène commun lors d'otite moyenne/interne chez les veaux laitiers. La durée du traitement doit être relativement longue et une récupération complète est possible.

(Traduit par les auteurs)

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Introduction

Otitis media has been reported in many of the domestic lifestock species: cattle (1–8), horses (9), swine (10), sheep (11), and goats (12). In humans, acute otitis media is the most common childhood bacterial infection, and the most common reason for prescribing an antibiotic in children (13). In calves, otitis media is relatively common (1), but it remains subclinical in several cases (7). Both preweaned and postweaned calves up to 18 mo of age can be affected (6). Otitis media can occur in both dairy and beef cattle, the latter being more commonly affected (6). Otitis media may result from extension of otitis externa infection, colonization from the auditory tube, or bacteremia (14). If left untreated, this disease can progress to otitis interna and meningitis (7). Pathogens isolated from otitis media, otitis interna, or both in calves include *Haemophilus somnus* (2,3), *Pasteurella multocida* (1,5), *Mannheimia haemolytica* (8), *Streptococcus* spp. (4), *Arcanobacterium pyogenes*

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(4,7,8,15), *Mycoplasma bovis* (6,15), and the ear mite *Raillietia auris* (16). Herd morbidity estimates in dairy cattle ranged from 1% (15) to as high as 80% in individually housed calves (5). Clinical findings associated with otitis media, otitis interna, or both in calves include paresis or paralysis of the pinna and head tilt, which is related to nerve inflammation, as well as purulent discharge from the external ear canal and epiphora (14).

The objective of this retrospective study was to review epidemiological data, clinical signs, ancillary test examination findings, and outcomes in dairy calves diagnosed with otitis media, otitis interna, or both referred to the Centre hospitalier universitaire vétérinaire (CHUV) de l'Université de Montréal.

Materials and methods

Medical records of all calves admitted to the CHUV between 1987 and 2002 with a clinical diagnosis of otitis media, otitis interna, or both were reviewed. Clinical diagnosis of otitis media or otitis interna was based on specific clinical signs: head tilt, drooping of the ear, or both; or purulent discharge from the affected ear. Clinical diagnosis was confirmed by means of radiographs, aural examination, or both.

For each case, initial data extracted from the medical record included age, sex, breed, month and year of hospitalization, duration of disease prior to admission, and feeding program. Clinical signs and concurrent diseases diagnosed were also recorded.

Results of the following ancillary procedures were recorded when available: complete blood cell (CBC) count on the day of admittance to the CHUV, radiographs of the tympanic bullae and lungs, analysis of cerebrospinal fluid (CSF) collected from the lumbar sacral space, and bacterial culture of aural discharge, tracheobroncheal samples, or both. Tracheobroncheal samples were collected either by transtracheal wash or via brush or lavage at the level of the 1st apical lobe bronchus during endoscopic examination of the respiratory system. Aural discharge was sampled by using a sterile swab via the external ear canal on living animals or in the middle ear at necropsy. Routine bacterial culture was performed on all samples. Samples were inoculated onto Columbia agar plates (DIFCO, Detroit, Michigan, USA). Anaerobic cultures were performed on an Ana-genta agar plate (DIFCO). Bacterial cultures were considered negative if no bacterial growth was detected after 5 d. Culture for *Mycoplasma* spp. was performed only when requested and then on Hayflick agar plates (18) (DIFCO). Plates were evaluated every 2 d and were considered negative if no growth was present after 7 d.

Antimicrobial and dosage during hospitalization were noted. Follow-up information was obtained via phone conversation with the owners.

Results

Medical records from 15 dairy calves (14 Holstein, 1 Ayrshire) were included in this study, based on our selection criteria. This proportion of Holstein is keeping with the breed population of calves referred to the CHUV. There were 14 females and 1 male, ranging from 2 to 18 wk (median = 4 wk) of age. One case was referred in 1987, 1 in 1991, 5 from February 1995 to August 1997, and 8 from December 2001 to November 2002. Seven of the 15 calves were referred during the fall, 4 during the winter, 2 during the spring, and 2 during the summer (Table 1). Information about the duration of the disease prior to referral was available in 12 cases and ranged from 0 d to 6 wk (mean = 2.8 wk). Eight out of 9 calves for which information was available were fed whole milk at the farm of origin.

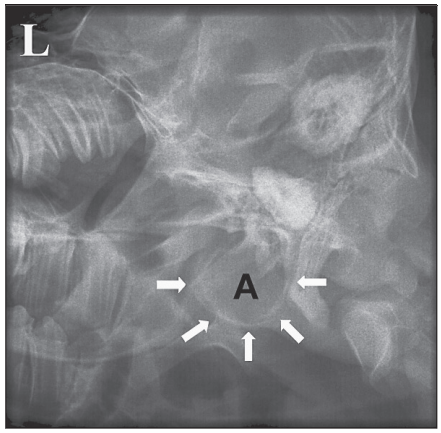

Figure 1. Lateral oblique projection of the left tympanic bulla of a calf with left otitis media/interna. [A] Opacification of the normal air filled bulla and lysis of the trabeculae of the tympanic bulla. Black arrows: thickening of the osseous bulla. White arrows: increased size of the tympanic bulla.

All calves included in the study presented neurological signs associated with otitis media or otitis interna. These included head tilt (n = 13), ptosis (n = 7), paresis or paralysis of the pinna (n = 8), ataxia (n = 2), strabismus (n = 2), and convulsions (n = 1). Six of 15 calves presented with epiphora. Aural examination was performed in 12 calves and purulent discharge was present in 8. At least 1 concomitant disease was diagnosed by physical examination in 12 animals. Pneumonia was the disease most frequently associated with otitis media, otitis interna, or both (n = 11), followed by septic arthritis (n = 3), diarrhea (n = 2), and umbilical infection (n = 2).

Neutrophilia was observed in 11 calves (range: 4 to 17.7×10^9 cells/L; mean = 7.7×10^9 cells/L), monocytosis in 8 calves (range: 0.9 to 3.8×10^9 cells/L; mean = 2×10^9 cells/L), and increased fibrinogen concentration in 12 calves (range: 5 to 9 g/L; mean = 6 g/L). Radiographic images of the tympanic bulla were taken in 13 calves. Abnormal findings were present in 12 cases. Radiographic lesions included opacification of the normal air-filled bulla, thickening of the osseous bulla, lysis or irregularities of the wall and trabeculae of the tympanic bulla, and change in size of the tympanic bulla (Figure 1). Lesions were bilateral in 7 cases and unilateral in 5. Thoracic radiographs were obtained for 11 calves. Radiographic findings were compatible with bronchopneumonia in 6 calves and with bronchopneumonia and abscessation in 2 calves. Cerebrospinal fluid (CSF) analysis was carried out in 5 cases and considered normal in 3. Pyogranulomatous inflammation was diagnosed in 2 cases.

Bacterial culture of purulent aural discharge was performed in 8 cases. Routine bacterial culture was

Table 1. Epidemiological data, bacterial culture results, concurrent diseases, duration of treatment, and outcome of the 15 calves

Case	Age[a]	Date of hospitalization	Aural discharge culture		Concurrent diseases		Duration of treatment[b]	Outcome
			Routine	Mycoplasma	Bronchopneumonia	Others		
1	8	December 1987	NP	NP	yes	diarrhea	7	NA
2	18	April 1991	negative	NP	no	none	15	NA
3	14	February 1995	negative	NP	yes	umbilical hernia	17	complete recovery
4	10	February 1995	NP	NP	yes	septic arthritis	17	NA
5	12	November 1996	NP	NP	yes	none	24	NA
6	2	March 1997	negative	*M. bovis*	no	none	20	NA
7	6	August 1997	negative	*M. bovis*	yes	diarrhea	19	complete recovery
8	2	December 2001	NP	NP	yes	none	34	complete recovery
9	2	January 2002	NP	NP	yes	none	22	recovery with persistant neurological signs
10	6	May 2002	*P. multocida*	*M. bovis*	yes	septic arthritis	0	necropsy
11	4	September 2002	negative	*M. bovis*	yes	none	19	relapse, persistant neurological signs, abnormal growth
12	3	October 2002	negative	*M. bovis*	yes	umbilical abscess	17	persistant neurological signs, abnormal growth
13	3	October 2002	NP	NP	no	none	18	euthanasia after 4 weeks of treatment
14	3	November 2002	negative	*Mycoplasma* spp.	no	septic arthritis	0	necropsy
15	4	November 2002	NP	NP	yes	none	26	complete recovery

NA — not available; NP — not done
[a]Weeks
[b]Days

performed in all cases and mycoplasmal culture was performed in 6 cases. Only 1 routine bacterial culture was positive. The 6 samples submitted for mycoplasmal culture were positive. A *Mycoplasma bovis* was isolated in pure culture in 4 cases and in combination with *Pasteurella multocida* in 1 case. *Mycoplasma* sp. was isolated in pure culture in 1 case (Table 1).

Aural discharge and a tracheobronchial sample were submitted at the same time for culture in 5 cases. In 4 cases, the same pathogens were cultured from both samples: *M. bovis* in pure culture in 3 cases, and *M. bovis* and *P. multocida* in the 4th case. In the 5th case, a *Mycoplasma* sp. was isolated in pure culture from the aural discharge, but the trancheobronchial sample was not submitted for mycoplasmal culture.

The most commonly used antimicrobial was enrofloxacin (n = 7), but it was never used as the 1st antimicrobial treatment at the CHUV, except in 2 cases for which several antibiotics had been administered previously at the farm without producing clinical improvement. Other antibiotics used included ampicillin (n = 5), penicillin (n = 4), spectinomycin (n = 4), trimethoprim/sulfamethoxazole (n = 4), and rifampin (n = 2). Eight animals received more than 1 antimicrobial regimen during their hospitalization at the CHUV. Antimicrobial regimens were altered following 3 d of absence of clinical improvement. Average duration of treatment was 19.6 d (range: 7 d to 34 d). Treatment was attempted in 13 calves. Calf 10 and 14 were euthanized because of severe bronchopneumonia and severe septic arthritis of the right carpus, respectively. Five out of 8 treated animals for which information was available recovered completely, although 1 case had persistent neurological signs (Table 1).

Discussion

In this retrospective study, *M. bovis* was the pathogenic agent most commonly involved in otitis media. A *Mycoplasma* sp. was the only organism isolated in all cases except 1 where it was combined with *P. multocida*. All but 1 of *Mycoplasma* spp. cultured were *M. bovis*, which is the major *Mycoplasma* sp. affecting cattle in North America (19). In studies involving beef and dairy cattle, the primary pathogens isolated from otitis media were *P. multocida, M. haemolytica, H. somnus*, and *A. pyogenes*, but culture for *Mycoplasma* spp. was not specifically requested (1,7,8). Outbreaks of otitis media in calves due to *M. bovis*, alone or in combination with *P. multocida* and *A. pyogenes*, has already been reported in dairy herds (5,6,15) and in beef cattle (20). Most calves had received antibiotics before being admitted to the CHUV. On the other hand, mycoplasmal culture was not requested in all cases. So at CHUV, previous antibiotic treatment and not culturing specifically for *Mycoplasma* spp. may explain some of the negative culture results. The results of this study confirm the

important role that *M. bovis* has in otitis media or otitis interna and establish that *M. bovis* is probably the most important etiological agent associated with otitis media or otitis interna in dairy calves.

Calves were principally admitted to the CHUV for otitis media between 1995 and 1997 and during the year 2002. Yearly climatic fluctuations have been reported as being associated with the variation of the incidence of otitis media (1). Since the number of cases referred to CHUV in 2002 increased markedly, we believe that climate alone cannot explain the magnitude of the increased prevalence observed. Walz (6) suggested that the outbreak of otitis media due to *M. bovis* in a dairy herd in Michigan might be associated with the increased incidence of mastitis caused by *M. bovis*. In 2002, the number of mycoplasmal infections diagnosed by the provincial laboratory in Québec (21) had increased considerably, suggesting a phenomenon similar to that proposed by Walz (6).

In this study, 10 of the 15 calves affected with otitis media, otitis interna, or both were 2 to 6 wk of age, and 11 of the 15 cases occurred between the months of October and March. The ages and time frame are in agreement with those of previous reports (6,8). The remaining 5 calves were aged 8 to 18 wk. In bull calves, acute otitis media has been reported as occurring typically during their 1st mo in feedlots and a chronic form of otitis media as developing in yearlings between 12 and 18 mo (1). Previously, Jensen (1) had suggested that the chronic form is the consequence of improperly healed acute infections that occurs in younger calves. In this retrospective study, duration of disease prior to hospitalization was quite similar in both age groups, which does not agree with Jensen's findings. The propensity for *M. bovis* to infect younger calves (22), combined with the increased prevalence of mycoplasmal infection in Québec in 2002 (21), could explain the increased number of younger calves referred to the CHUV in 2002.

As previously reported (1), respiratory infection and otitis media are often concurrent diseases. Since they affect calves of the same age and during the same season, common risk factors or etiology probably exists. Also, the bacteria most commonly involved in bronchopneumonia are also those involved in otitis media. In this study, the same pathogens were cultured from aural discharge and tracheobronchial samples in 4 of 5 cases.

In humans, viral infection of the nasopharynx and subsequent disruption of the function of the eustachian tubes is believed to be part of the pathophysiology of otitis media. Bacteria from the nasopharynx may reach and colonize the middle ear and proliferate (13,23). No virus isolation was attempted in this study. Viruses cannot be eliminated as primary causative agents. The eustachian tube appears to be the most common portal of entry of pathogens to the middle ear in calves, but in this study, 4 calves did not show clinical signs of respiratory disease at the time of admission. In these animals, undiagnosed pharyngitis or laryngitis, infection of the external ear canal, or bacteremia could have been responsible for the infection. One animal in the present study was diagnosed with septic arthritis and otitis media, but without signs of concurrent respiratory disease. *Mycoplasma bovis* was isolated from the septic joint and aural discharges. In this particular case, it remains unclear if septic arthritis or otitis media was the primary location of the infection, or if both were secondary to a bacteremia. Infection of the middle ear via the external ear canal cannot be completely eliminated as a cause of otitis media. The isolation of *M. alkalescens* and *Mycoplasma* sp. Leach group 7 from the ear of a cow suggested that the external ear could have been a reservoir of infection (24).

Ingestion of colostrum or milk from cows subclinically or clinically infected was reported to be of importance in the pathogenesis of otitis media due to *M. bovis* (6), *Streptococcus* sp., and *Actinomyces* sp. (4) in calves. In the present study, 8 out of 9 cases were fed whole milk, which could have included milk from sick cows; therefore, ingestion of whole milk could have been a risk factor in this study.

The clinical signs of otitis media, or interna, in this study are similar to those previously reported (1,6–8,15); 9 of 13 cases for which results of aural examination were available had purulent aural discharge. Purulent aural discharge was present in all cases of otitis media in previous reports (2,7,8,25). However, in Walz's study (6), none of the 5 cases reported had a purulent aural discharge. Purulent discharge is reported to appear 2 to 3 d after apparent clinical signs and is associated with rupture of the tympanic membrane (8,25). Since this study was retrospective, it may have underestimated the number of cases with aural discharge, since there is no certainty that the ear was examined.

Radiographic images of tympanic bulla in calves obtained for the diagnosis of otitis media had been reported (7) and were useful in this study. In small animals, radiographs are considered helpful in diagnosing otitis media (26). Evaluation of the tympanic bulla is best achieved with lateral oblique or open-mouth projections (27), and in cases of unilateral infection, open-mouth views facilitate the diagnosis by allowing comparison between the 2 tympanic bulla. Increased opacity or thickening of the osseous bulla is suggestive of otitis media (26). Only lateral oblique projections were performed in the present study. These views were taken with minimal restraint and without sedation. Calves cannot open their mouth enough for open-mouth radiographic views. Remedios (27) reported that when radiographs of the tympanic bulla were abnormal, surgical observations were consistent with otitis media; however, 25% of patients with normal radiographs had some abnormalities during surgery. Therefore, radiographs of the tympanic bulla should be considered as a specific, but not a sensitive, diagnostic tool for otitis media.

The inner ear is located within the petrous temporal bone and communicates with the CSF only via the cochlear duct. In cattle, as well as in humans, the relationship between the perilymph of the inner ear and CSF is not well understood (28). To our knowledge, any changes to the CSF following inner ear infection have been complicated by meningitis. In the present study, the changes to the CSF analysis seen in 2 calves with clinical signs of CNS disease were compatible with an inflammation of the CNS. In the 3 other animals that had only clinical signs of peripheral vestibular disease or facial nerve dysfunction the CSF was normal. When a complication of CNS disease is suspected

in cases of otitis media or otitis interna, CSF analysis appears to be an important ancillary test.

Full clinical recovery was observed in 60% of calves in this study. In previous studies, complete recovery has been reported in 100% of cases (n = 8, 20) (2), (n = 15) (24), (n = 5) (7), (n = 64) (8), even if some recurrences were reported (8). According to Radostits et al (29), antimicrobial therapy is commonly unsuccessful and the prognosis should be considered as guarded. In cases of mycoplasmal otitis media, Walz (6) reported a mortality rate of 50%. The prognosis appears to depend on the chronicity of disease and the etiologic agent involved.

Enrofloxacin was the antimicrobial most commonly used in this study. Yeruham (8) previously reported successful treatment of otitis media with enrofloxacin. It has a broad spectrum of activity and is reported to be effective against bacteria involved in otitis media, such as *M. haemolytica, P. multocida*, and *M. bovis* (30). Also, because of its pharmacodynamic and pharmacokinetic properties, it should penetrate to the middle ear (30,31). On the other hand, it is not licensed for the treatment of otitis media in cattle and there is a growing concern about the possible development of fluoroquinolone resistance in veterinary and human medicine (32). In North America, enrofloxacin is labelled in the United States only for the treatment of respiratory disease in beef cattle. Its use in farm animals is prohibited in any other situations (32). In this study, enrofloxacin was never used as the primary antimicrobial treatment and all calves in which it was used had presented clinical signs of respiratory disease.

In North America, other antimicrobial drugs that could be used to treat mycoplasmal infections in cattle are tetracycline, spectinomycin, tylosin, tilmicosin, and florfenicol. Tylosin, tilmicosin, and florfenicol were not used in this study, because frequently they had been administered previously at the farm; furthermore, since tilmicosin and florfenicol are approved for use in cattle in North America only as long acting preparations, their use in a case necessitating multiple days or weeks of treatment becomes difficult. Due to the reported increased resistance of European mycoplasmal strains to oxytetracycline and tilmicosin (22), these antimicrobials were also avoided in this study. Spectinomycin was used as the 1st treatment regimen in 4 cases. Poor clinical improvement was observed in 3 of these cases, and no follow-up data was available for the 4th case.

Antibiotics were administered for an average of 19.6 d in the present study. In humans, a 7- to 10-day course of antibiotic treatment is recommended for acute otitis media (13). In small animals, 4 to 6 wk of antibiotic therapy is recommended (34). Optimal therapy of otitis media in cattle remains to be determined. Pathogens involved in otitis media in humans (13,23) and in dogs (33) are different from those involved in cattle. Consequently, extrapolation of duration of treatment from humans or small animals cannot be made. Some authors have proposed a duration of treatment of several weeks (34), whereas others have observed a clinical remission after 5 to 7 d of treatment (25). The chronicity and implicated pathogens could influence the duration of treatment. In this study, most cases were chronic, which can explain the necessity of a prolonged treatment. Acute disease has been reported to have been treated successfully with antimicrobials, whereas such treatment for chronic disease may not be successful (1). In feedlots, chronic otitis in older animals was suspected to be a recurrence of an otitis media contracted as calves (1). It is necessary to determine an adequate treatment regimen, including duration of treatment and most effective antimicrobial drug, to prevent recurrence and chronic evolution.

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