Nocardia Mastitis

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Nocardia has been long recognized as an important pathogen of cattle, causing acute to chronic forms of mastitis. *Nocardia asteroides* was first reported in 1958 by Pier, *et al*[5] as causing a herd outbreak in a southern California dairy. Similarly, sporadic outbreaks have been reported in other areas of the USA and other countries.[4,7,8] Introduction and spread of the nocardia has been traced to improper hygienic practices of intramammary therapy. Identification of contaminated drugs, drug vials and infusion cannulas has been linked to herd outbreaks[5]. Infusion of *Nocardia spp.* during the dry period may set up foci of infection without showing clinical signs until after parturition. The normal process of lactogenesis causes expansion of the gland and disruption of the existing foci, leading to severe clinical mastitis in the early postpartum period.[2]

Climatic conditions may play a role in environmental concentration of the organism, leading to herd contamination. Once established in a herd, subsequent spread of nocardial infections may occur from cow to cow.[6] The spread of nocardia from environment or cow to cow has not been experimentally tested or confirmed.

Clinical Aspect

Nocardial mastitis is characterized as a severe acute infection progressing to a chronic, suppurative, granulomatous infection which develops draining sinus tracts to the exterior.[3] However, *Nocardia asteroides* has been cultured from quarters showing no clinical signs of mastitis. Nocardial infections range from subclinical or chronic to severe acute mastitis. Most infections will lead to gland disruption and progressive fibrosis. In the severe acute form, a 5 to 10% death rate may be expected.[2] Infections developing in midlactation will normally be manifested as a less severe chronic mastitis. These subclinical infections with intermittent clinical flare-ups have been identified with increasing frequency in herd culture surveys.

Culture and Identification of the Organism

Nocardia can be tentatively identified directly from milk smears as a gram positive organism with branching filaments or simple rod or coccoid forms. These partially acid-fast organisms grow slowly on blood agar, occasionally appearing in 24 or 48 hours, but often requiring 72 to 96 hours incubation for detection. If blood agar cultures are discarded at 24 or 48 hours these organisms may be excluded from routine diagnosis. The organisms grow into the agar with young colonies exhibiting a chalky white appearance which turns yellow to dark orange upon aging. The colonies may appear as smooth to rough in consistency and irregular in shape (figure 1). Colonies adhere tightly to the blood agar and are not easily removed by normal stab technique. These small adherent colonies on blood agar are almost diagnostic of nocardia. When organisms are removed from plates by light rubbing with an inoculation loop and stained with a gram stain, nocardia appear as slender branching filamentous forms but often fragment into short rod and coccoid elements (figure 2). Growth in brain heart infusion broth produces elements which float to the surface or settle in a flocculant precipitate at the bottom of the tube.

Epidemiological Survey

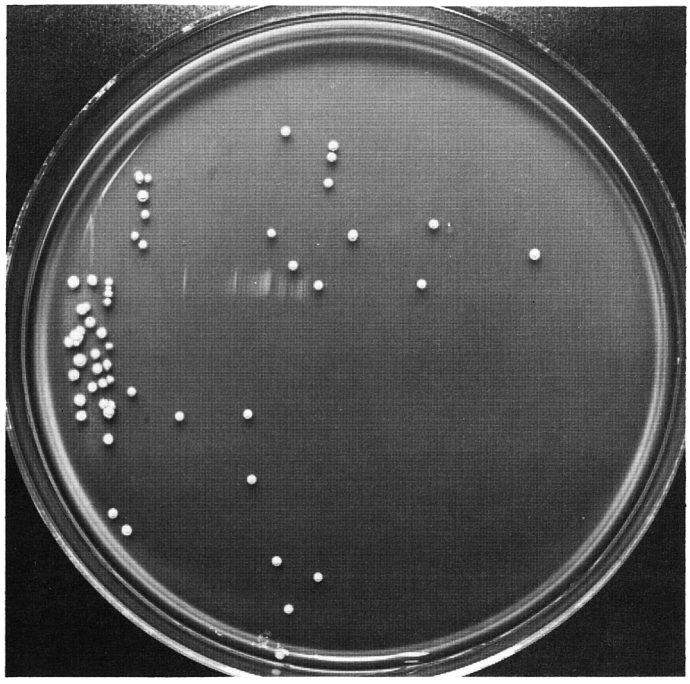
Recent bacteriological surveys of milk samples from Mississippi dairy herds have identified sporadic subclinical and chronic cases of nocardial mastitis. Of 2668 composite milk samples from 18 herds, 10 herds identified one or more nocardia infected cows with 35 cows positive for nocardia for a herd prevalence of 55% and a cow prevalence of 1.3%. Each positive sample was confirmed by quarter sampling and reculture. All 35 infected cows had single quarter infections. Many of the infected quarters had been treated with a variety of antibiotic products on numerous occasions. Of 293 quarters with clinical mastitis quarters sampled, 12 nocardial infections were identified for an infection prevalence of 4%.

Single quarter infections would indicate a point source infection. Direct spread from the environment, milking equipment or procedures would seem unlikely, since their direct involvement should produce multiple quarter infections as seen in other mastitis conditions. Most contagious mastitis spreads more rapidly from quarter to quarter than cow to cow. However, in herds with a high prevalence, the concentration of nocardia may make mechanical spread a larger threat.

Results of a Kirby-Bauer antibiotic sensitivity testing on each of 17 isolates of *Nocardia asteriodies* are shown in Table 1. From the *in vitro* sensitivity testing, the antibiotic of choice is erythromycin since all isolates were susceptible and it demonstrated zones of inhibition with a mean diameter of 33 mm. In order of sensitivity and percent of isolates susceptible, the most effective drugs are erythromycin and

Figure 1. Growth of *Nocardia asteroides* on blood agar producing adherent chalky white to yellow colonies after 96 hours incubation a) 1X b) 10X.

A



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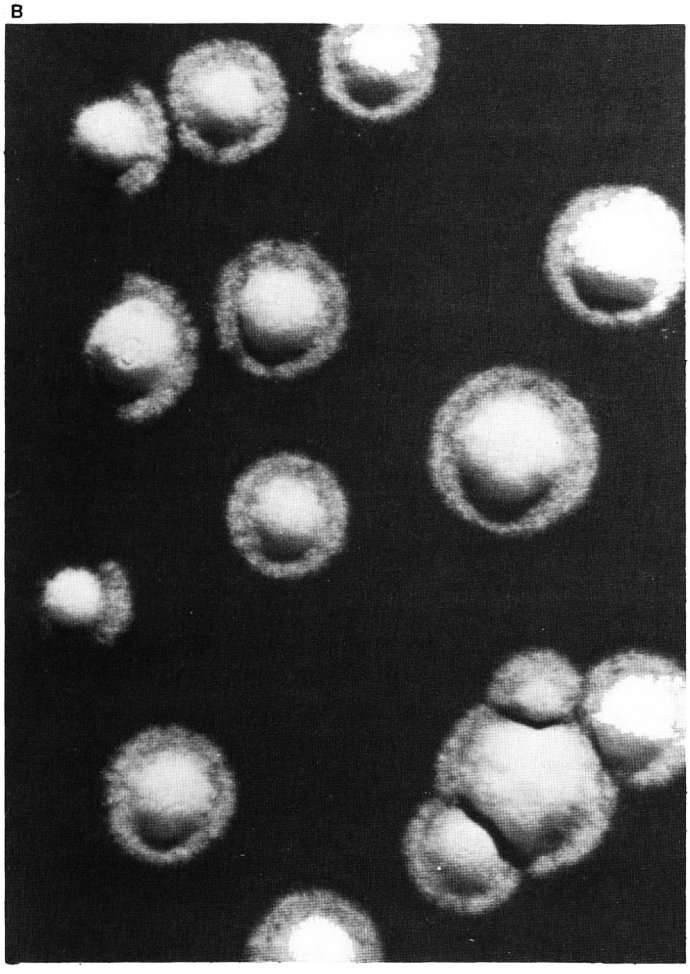

Figure 2. *Nocardia asteroides* stain as gram positive rod to coccoid forms with branching filaments. (1000X)

TABLE 1. Antibiotic Sensitivity Patterns of **Nocardia** spp from Bovine Mastitis

	Sensitivity Zone (mm)[a]	Mean diameter (mm)[b]	Range (mm)	Sensitivity Number	Percent
Amicillin	29	32.7	15-40	8/17	47
Cephalosporin	15	7.4	0-30	2/17	11
Chloromycetin	18	18.7	0-28	6/17	35
Cloxacillin	14	2	0-22	1/17	5
Erythromycin	18	33	26-50	17/17	100
Furacin	17	9.4	0-25	5/17	29
Gentamycin	13	9.1	0-25	5/17	29
Kanamycin	18	12.6	0-28	6/17	35
Neomycin	17	17.4	0-30	13/17	76
Novobiocin	22	22.9	15-34	7/17	41
Penicillin G	22	2	0-35	1/17	5
Polymyxin B.	12	1.2	0	0/17	0
Streptomycin	15	7.9	0-30	4/17	23
Tetracycline	19	12.9	0-30	5/17	29
Triple-sulfa	17	6.9	0-32	4/17	23
Miconizol[c]		22.3	18-40	17/17[d]	100

[a] Minimal inhibitor zone standard by Kirby-Bauer Method
[b] Mean inhibitory zone value for 17 isolates of nocardia
[c] 100 mg per disc
[d] Number of nocardia greater than 18 mm

miconizol[a] effective against all isolates, with decreasing sensitivity to neomycin, ampicillin, novobiocin, chloromycetin and kanamycin (table 2).

Erythromycin, novobiocin and ampicillin used for extended periods of 1-2 weeks during the lactating period reduced clinical signs of nocardial mastitis, but did not eliminate the infection. Cloxicillin and novobiocin in a dry

[a] *Miconizol Nitrate, Sigma Chemical Company, St. Louis, Missouri, 63178*

TABLE 2. Susceptability of Nocardial Isolates to Various Antibiotics and Chemotherapeutic Agents

Drugs	Number Sens/Total	Percent Sensitivity
Miconizol	17/17	100
Erythromycin	17/17	100
Neomycin	13/17	76
Ampicillin	8/17	47
Novobiocin	7/17	41
Chloromycetin	6/17	35
Kanamycin	6/17	35

cow preparation did not eliminate infections during the non-lactating period. Miconizol is being evaluated experimentally since it has demonstrated good *in vitro* sensitivity against nocardia by both the Kirby-Bauer and minimum inhibition concentration (MIC) methods.[1] A concentration of 10 ug/ml was effective in inhibiting growth of nocardia *in vitro*. Doses of 13 ug/ml or 200 mg per quarter are being experimentally evaluated for effectiveness in both lactating and non-lactating cows. Results appear promising but no conclusions can be made from the limited data available.

Summary

Nocardial infection is usually characterized as a severe acute mastitis, but may manifest itself in less severe, chronic forms. Although it is present in the soil, introduction of the organism into the udder is associated with contamination during mastitis therapy. Single quarter infections support point source as the major means of introduction. Limitation of nocardial infections to areas of the country with warmer climatic conditions may associate prevalence with soil concentration, but this has not been confirmed. If clinical laboratories testing for mastitis pathogens are not routinely sampling entire herds, or if cultures are not maintained for 72 to 96 hours, nocardial infections will be missed which may account for lower prevalence reported in other areas of the country.

References

1. Bauer, A.W., Kirby, W.M.M., Sherris, J.C. and Turck, M.: 1966. Antibiotic Susceptibility Testing by a Standardized Single Disk Method. Amer. J. Clin. Pathol. 45:493-496. 2. Bushnell, R.B., *et al.*: 1979. Clinical and diagnostic aspects of herd problems with nocardial and mycobacterial mastitis. Amer. Assn. Veterinary Lab. Diag. 22nd annual Procedings. 1-12. 3. Carter, G.R.: 1979. *Diagnostic Procedures in Veterinary Bacteriology and Mycology*. 3rd ed. Thomas Publisher, Springfield, IL. pg 207-210. 4. Orchard, V.A., 1979. Nocardial Infections of Animals in New Zealand, 1976-1979. Vet. J. 27:159-160 & 165. 5. Pier, A.C., Gray, D.M. and Fossatti, M.J.: 1958. *Nocardia Asteroides* - A Newly Recognized Pathogen of the Mastitis Complex. AJVR 19:319-331. 6. Schalm, O.W.: 1971. *Bovine Mastitis.* Philadelphia, Lea and Febiger, 267-269. 7. Shigidi, M.T.A., Mirghani, T. and Musa, M.T.: 1980. Characterization of *Nocardia farcininca* isolated from Cattle with Bovine Farcy. Reseach Vet. Sci, 28:207-21. 8. Verdura, T. and Joa, R.: 1977. Association of bacteria of *Nocardia spp* with yeast in diseases of the mammary gland with respiratory complications (in cows). Revista Cubana de Ciancins Veterinarias 8(1):21-24.