Incidence and Transmission of Bordetella Infections in Swine

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Story in Brief

A survey of the incidence of *Bordetella bronchiseptica* was made in two Oklahoma State University swine herds. Approximately 9.7 percent of the sows in herd 1 were positive and only one positive sow was observed in herd 2. The repeatability of positive cultures in positive sows was poor.

In a second study, no distinct differences were observed in the bacterial populations between pigs with early symptoms of atrophic rhinitis and pigs not showing early symptoms of the disease. Pigs exhibiting early symptoms of atrophic rhinitis, however, were found to have a much higher incidence and degree of turbinate atrophy at slaughter. All isolates of *Bordetella bronchiseptica* found in the OSU swine herds were resistant to sulfonamides.

Introduction

The cause of infectious atrophic rhinitis has been under active investigation for well over a century. During this time it was established that inoculation of very young pigs with turbinate lesion material would result in the transmission of atrophic rhinitis. This has led most workers to accept atrophic rhinitis as an infectious disease. The underdevelopment of the nasal bones appears to be due to a failure in bone growth associated with infection within the nasal cavity itself. Experiments have shown that several species of bacteria are possibly involved in causing atrophic rhinitis, but results to date suggest that *Bordetella bronchiseptict* is probably the bacteria most often responsible.

The extent of atrophic rhinitis in the swine population is difficult to determine as relatively few surveys have been made. Estimates of the incidence of atrophic rhinitis by examination of nasal turbinates has ranged from 5 to 40 percent of the pigs examined. The largest survey of over 1600 swine slaughtered from 1962 to 1969 indicated an incidence of about 25 percent.

Bordetella bronchiseptica has been found to be widely distributed among the swine population. In a recent survey, *B. bronchiseptica* was found in the nasal cavity of 54 percent of 87 Iowa purebred swine herds. It would appear that the incidence of *B. bronchiseptica* is also wide-

spread in certain animal populations. An incidence of *B. bronchiseptica* has been observed in the rat, skunk, rabbit, opossum, fox, raccoon, dog and cat.

The fact that *B. bronchiseptica* is so widespread among a number of animal species suggests that this organism may be difficult to control. This difficulty is possibly reflected by the fact that 60 percent of the herds which failed to pass the SPF slaughter check failed as a result of turbinate atrophy. Not all isolates, however, are capable of producing turbinate atrophy. Results in one study indicated that four isolates of swine origin, an isolate of rabbit origin and an isolate of cat origin caused mild to moderate turbinate atrophy in 22 of 24 pigs. An isolate of rat origin caused mild turbinate atrophy in one of four pigs and an isolate of dog origin caused no turbinate atrophy.

Since a dagree of turbinate atrophy has been observed in the Oklahoma State University swine herds, studies were undertaken to determine the incidence of *B. bronchiseptica* in two of the University swine herds through recently developed techniques involving nasal swabs and cultures of the organism.

Phase I

All sows and gilts in the teaching herd and all sows in the animal breeding herd were used in the initial phase of this study which was conducted between October, 1971 and August, 1972. Standard procedures for swabbing and culturing for *B. bronchiseptica* were used. Sows in the teaching herd were swabbed from two to seven times each and sows in the animal breeding herd were swabbed twice. Gilts were swabbed once.

Results of the initial survey (Table 1) indicated a distinct herd difference in the incidence of *B. bronchiseptica*. The incidence observed in herd 1 (9.7 percent) is in agreement with the findings of other research workers who observed an incidence of 10 to 15 percent in problem herds. Only one sow in herd 2 was positive. A breed difference in herd 1 was observed with Yorkshire sows exhibiting a higher incidence of *B. bronchiseptica* than Hampshire sows. The highest incidence was observed in Yorkshire gilts in herd 1.

It should be noted that although the positive sows were swabbed numerous times (a miximum of seven times for one positive sow), no sow was positive more than once (Table 2). This lack of repeatability of positive swabs needs to be explained before this system has any practical applications as a means of eliminating carrier animals in this herd. It is posible that *B. bronchseptica* exisits in large numbers in the nasal passages of carrier animals in one herd and are present in

Table 1. Incidence of Bordetella Bronchiseptica in Sows and Gilts From Two OSU Swine Herds

Breed Groups	Herd 1[1]			Herd 2[2]		
	No. Swabbed[3]	No. positive	% positive	No. Swabbed[4]	No. positive	% positive
Duroc sows	--	--	--	27	0	0
Hampshire sows	35	1	2.8	32	1	3.1
Hampshire gilts	20	0	0	--	--	--
Yorkshire sows	41	5	12.2	30	0	0
Yorkshire gilts	28	6	21.4	--	--	--
Total	124	12	9.7	89	1	1.1

[1] OSU teaching herd.
[2] OSU animal breeding herd.
[3] A total of 299 swabs were made and each sow was swabbed from 2 to 7 times.
[4] All sows were swabbed twice.

Table 2. Repeatability of Bordetella Swabs in Positive Sows

Sow No.	No. of Swab						
	1	2	3	4	5	6	7
Y 91-1	—[1]	—	—	+[2]	—	—	—
Y 29-5	+	—	—	—	—		
H 15-2	—	—	+	—			
Y 15-11	—	—	+				
Y 60-6	+	—	—				
Y 17-4	+	—					
H 69-6	+	—					

[1] Indicates negative to *Bordetella bronchiseptica*.
[2] Indicates positive to *Bordetella bronchiseptica*.

only a small number of colonies in the nasal passages of carrier animals in another herd. If this is the case, the nasal passage swab and culture approach could be effective in eliminating carrier animals in one herd and not effective in another.

Phase II

The second phase of this study was initiated to determine if differences exist in the bacterial populations in sows and litters with early symptoms of atrophic rhinitis compared to sows and litters not showing early symptoms of the disease. The relationship between early sym-

toms of atrophic rhinitis and evidence of turbinate atrophy at slaughter was also studied.

A total of 5 sows with litters showing symptoms of atrophic rhinitis were selected as the "diseased" group and a group of 6 sows with litters not showing evidence of atrophic rhinitis were selected as the "control" group. Early symptoms used to designate a litter as a "diseased" litter included sneezing, nasal discharge, irritation of the nasal passages (such as rubbing of the snout against convenient objects), and discharge from the eye.

Sows and litters were divided into the two groups as quickly after farrowing as possible and moved from the farrowing house to two separate nursery facilities. This procedure permitted the isolation of the two groups until the pigs were slaughtered. The sows from each litter were swabbed at two week intervals until the litters were weaned. Four pigs from each litter were swabbed at two week intervals until the pigs reached 3 months of age. Another swab check was made when the pigs reached 4 and 5 months of age.

The pigs involved in the swabbing checks were slaughtered and the maximum distance from the scroll of the turbinates to the parietal surface of the nasal cavity was measured. An antibiotic sensitivity check was made on all isolates of *B. bronchiseptica.*

The incidence of selected bacteria from the "control" and "diseased" groups is presented in Tables 3 and 4. The incidence of *B. bronchiseptica* throughout the trial in both groups was very low. Only one positive culture from a total of 129 samples was observed in the "control" group and none of the sows were positive. Only one sow in the "diseased" group was positive to *B. bronchiseptica,* but 20 percent of the pigs at approximately four months of age were positive. Other workers have observed a very high incidence of *B. bronchiseptica* in young pigs with a gradual decline in the incidence with age. No differences between the "diseased" and "control" groups in the incidence of other bacteria were observed except for the increased incidence of *Pasteurella multocida* in the "diseased" sows. *Pasteurella multocida* has been implicated as a causative agent for rhinitis. The incidence of mycoplasma ranged from 20 to 47 percent and did not appear to differ greatly between treatment groups.

The average maximum distance from the scroll of the turbinates to the parietal surface of the nasal cavity was greater for the "diseased" pigs than for the "control" pigs (Table 5). This suggests that more turbinate atrophy had occurred in the "diseased" group. Of the pigs slaughtered only one of 13 pigs in the "diseased" group could be listed as negative to atrophic rhinitis while 10 of 18 could be listed as negative to

Table 3. Incidence of Selected Bacteria from "Control" Sows and Litters

Microorganism	Sow		Pigs					
	Farrow to weaning		Month 1, 2, 3		Month 4		Month 5	
	Total No. of swabs	% Positive	Total No of swabs	% Positive	Total No. of swabs	% Positive	Total No. of swabs	% Positive
Bordetella bronchiseptica	13	0	89	1.1	15	0	11	0
Pasteurella haemolytica	13	61.5	99	86.9	15	80	11	27
Pasteurella multocida	13	0	99	4.0	15	0	11	0
Pasteurella species	13	7.7	99	13.1	15	27	11	0
Mycoplasma	12	25.0	86	33.0	15	0	4	0

Table 4. Incidence of Selected Bacteria from "Diseased" Sows and Litters

Microorganism	Sow		Pigs					
	Farrow to weaning		Month 1, 2, 3		Month 4		Month 5	
	Total No. of swabs	% Positive	Total No of swabs	% Positive	Total No. of swabs	% Positive	Total No. of swabs	% Positive
Bordetella bronchiseptica	15	6.7	116	0	20	20.0	13	0
Pasteurella haemolytica	15	86.7	112	76.8	20	85.0	13	69.2
Pasteurella multocida	15	20.0	112	3.6	20	0	13	0
Pasteurella species	15	20.0	116	11.2	20	15.0	13	15.0
Mycoplasma	15	20.0	103	47.6	20	0	11	0

Table 5. Turbinate Atrophy of Pigs at Slaughter

	No. Pigs	Average Turbinate Measurement, mm[1]	Percent Positive[2]	Percent Negative[3]	Percent Suspect[4]
"Control" pigs	18	5.1	33	56	11
"Diseased" pigs	13	7.9	77	8	15

[1] Maximum distance from the scroll of the turbinates to the parietal surface of the nasal cavity.
[2] Pigs with maximum distance of 8 mm or more for right or left nasal passage.
[3] Pigs with maximum distance of 5 mm or less for right or left nasal passage.
[4] Pigs with maximum distance from 5 to 8 mm for right or left nasal passage.

Table 6. Sensitivity Test of all Bordetella Bronchiseptica Cultures Isolated

Antibiotic	No. Samples	No. Resistant	% Resistant
Chloromycetin	19	17	89
Erythromycin	19	18	95
Furadantin	19	19	100
Gentomycin Sulfate	19	2	10
Neomycin	19	19	100
Penicillin	19	19	100
Streptomycin	19	19	100
Sulfamerizine	19	19	100
Sulfamethazine	19	19	100
Sulfathiazole	19	19	100
Tetracycline	19	4	21

atrophic rhinitis in the "control" group. Two pigs from each group were listed in the suspect category.

The results of the sensitivity test for all nineteen of the samples of *B. bronchiseptica* are presented in Table 6. *Bordetella bronchiseptica* isolates were sensitive to only tetracycline and gentomycin sulfate. It is interesting to note that all isolates were resistant to all three sulfonamides. This is in agreement with the recent findings of an 80 percent resistance of *B. bronchiseptica* to sulfonamides in Iowa.