Glasser's disease and prevalence of subclinical infection with *Haemophilus parasuis* in swine in southern Ontario

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Abstract

Glasser's disease accounted for less than 1% of total swine mortalities in an 11 year retrospective postmortem survey of swine submissions at three provincial government diagnostic laboratories in southern Ontario. However, Glasser's disease was suspected in 17 of 83 boar mortalities at the Record of Production Boar Test Station between 1983 and 1985 and was much more common in specific-pathogen-free (SPF) boars than in conventional boars. The prevalence of the causative organism, *Haemophilus parasuis*, was determined for 19 SPF herds in Ontario classified as "Excellent" under the Ontario Swine Herd Health Policy. Nasal swabs from two-month-old pigs were cultured on chocolate agar containing 1.5 μg/mL lincomycin, 5 μg/mL bacitracin, and 0.1 μg/mL crystal violet. Three herds were negative for *H. parasuis* infection; 16 herds contained clinically healthy carrier pigs.

Résumé

La maladie de Glasser : prévalence et infection subclinique par *Haemophilus parasuis* chez des porcs du sud de l'Ontario

Dans une étude rétrospective des nécropsies effectuées sur des porcs soumis à trois laboratoires de diagnostic provinciaux du sud de l'Ontario, la maladie de Glasser a contribué à moins de 1% des mortalités. Toutefois, on soupçonne l'implication de la maladie de Glasser dans la mort de 17 verrats sur 83 à la Station d'évaluation et de production des verrats entre 1983 et 1985; la maladie de Glasser était plus fréquente chez les verrats « SPF ».

Ce taux de mortalité a influencé de façon significative la classification de l'état de santé. La prévalence de l'agent étiologique, *Haemophilus parasuis*, fut déterminée pour 19 élevages « SPF », classés « Excellent » en Ontario par l'« Ontario Swine Herd Health Policy ». Des écouvillons nasaux prélevés sur des porcelets âgés de deux mois ont été ensemencés sur des géloses chocolat contenant 1.5 μg/mL de lincomycine, 5 μg/mL de bacitracine et 0.1 μg/mL de cristal violet. Trois élevages furent négatifs pour *H. parasuis*, tandis que 16 présentèrent des porteurs sains.

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Introduction

Glasser's disease was first described by K. Glasser in 1910 (1), and has since been diagnosed throughout the world (2-7). The causative organism, *Haemophilus parasuis*, is considered to be part of the normal flora of the respiratory passages of conventionally raised pigs. Piglets acquire the organism soon after birth but, due to the presence of maternal antibodies, rarely develop disease (8). Immunity to Glasser's disease is usually developed by seven to eight weeks of age (8), thus the disease only occurs sporadically, mainly in pigs two to four weeks of age, subjected to stressful environmental conditions (3,4,9). However, specific-pathogen-free (SPF) pigs are often free from this organism and are therefore highly susceptible to Glasser's disease (7,8). Clinical signs appear three to seven days after infection with *H. parasuis*. The most common clinical signs of Glasser's disease are anorexia, pyrexia, lameness, recumbency and convulsions (10), but apparently healthy pigs may die suddenly during acute outbreaks. Classical postmortem lesions are fibrinous polyserositis, fibrinous polyarthritis, and fibrinous meningitis. However, when SPF pigs die suddenly from Glasser's disease, the postmortem lesions may be minimal (2,7). Under these circumstances, it may be difficult to differentiate Glasser's disease from other causes of sudden death because of the fastidious nature of *H. parasuis* under culture conditions (7,9).

For many years, the swine section of the Ontario Veterinary College at the University of Guelph, has provided cesarean-derived stock to populate SPF herds. During 1985-1987 a project was undertaken to evaluate the importance of Glasser's disease as a cause of mortality in cesarean-derived and secondary SPF pigs. In this paper, we report the frequency of diagnosis of Glasser's disease in swine submitted for postmortem examination and prevalence of *H. parasuis* in the SPF swine population classified as "Excellent" in southern Ontario.

Materials and Methods

This paper contains three sections: a retrospective postmortem survey of swine submissions to three provincial government diagnostic laboratories, and investigation of the mortalities occurring at the Ontario Record of Production (ROP) Boar Test Station, and a study of the prevalence of *H. parasuis* in the nasal cavity of SPF pigs.

Postmortem Survey

Three provincial government veterinary diagnostic laboratories located in southern Ontario provided records for this study. Records were obtained for the years 1974 through 1984 inclusive and were selected for further analysis if there was macroscopic evidence of

TABLE 1
Suspected and diagnosed cases of Glasser's disease 1974–1984 in southern Ontario

	Lab 1			Lab 2			Lab 3		
Year	Susp	Cul +	Cul −	Susp	Cul +	Cul −	Susp	Cul +	Cul −
1974		NA	NA	3	0	0	18	0	0
1975		NA	NA	5	0	0	22	2	0
1976		NA	NA	6	0	0	7	4	1
1977	17	1	2	5	3	0	20	4	2
1978	0	0	0	11	2	0	19	4	0
1979	3	0	0	13	7	0	21	0	0
1980	5	0	0	2	0	0	20	1	0
1981	6	1	0	4	0	0	8	2	0
1982	7	1	0	3	0	0	5	0	0
1983	17	1	1	5	0	0		NA	NA
1984	7	2	1	0	0	0		NA	NA
Total	62	6	4	57	12	0	140	17	3
Glasser's disease		16%			21%			14%	
Total pigs		5302			10807			17332	

Susp = Suspected, gross postmortem lesions compatible with Glasser's disease
Cul + = Glasser's disease, culture positive
Cul − = Glasser's disease, culture negative
NA = No data available
Glasser's disease = [(cul + plus cul −)/suspected] × 100%

acute or subacute polyserositis and polyarthritis where no noninfectious cause of death was immediately apparent on gross postmortem examination. These were referred to as suspected cases and from this group Glasser's disease cases were taken as follows:

A) Glasser's disease (culture positive) — suspected cases from which *H. parasuis* was recovered from tissues other than lung.
B) Glasser's disease (culture negative) — suspected cases where polyserositis was diagnosed in an SPF animal with a history of recent exposure to conventional pigs where no infectious agent (bacteria or mycoplasma) was cultured.

Test Station Mortality 1983–1985

The postmortem reports from all swine submissions from the Ontario ROP Boar Test Station during 1983–1985 were retrieved from the files of the Department of Pathology at the Ontario Veterinary College. The association between cause of mortality and the health status classification according to the Ontario Swine Herd Health Policy (OSHHP) (11) of the herd of origin was analyzed and evaluated statistically using the Chi square test.

The OSHHP health status classification include "Excellent", "Good" and "Basic". The Excellent category contains herds that are defined as free from clinically detectable atrophic rhinitis and enzootic pneumonia (11). These herds consist of pigs originating from cesarean-derived parent stock (primary SPF herds) or are populated from these existing SPF herds and are sometimes referred to as secondary SPF herds. In this paper, herds referred to as non-SPF are registered with the OSHHP and consist of conventionally raised pigs. A small number of SPF herds will be classified as Basic or Good while they are being evaluated for the Excellent classification. Therefore, in addition to comparing the causes of mortality between the health classifications of Excellent, Good, and Basic, mortality was also compared between SPF and non-SPF boars.

Prevalence of H. parasuis in SPF herds

In order to test the feasibility of diagnosing *H. parasuis* subclinical infection, nasal swabs from recently weaned pigs from five conventional herds were cultured. The same technique was then used to screen similar aged pigs from 19 SPF herds for infection with *H. parasuis*. In each herd, ten pigs were selected at random from different pens. This number is based on an assumed prevalence of *H. parasuis* of almost 100% in carrier pigs housed in groups (8). At this level of prevalence, selection of ten animals per herd is suitable for detecting the presence of *H. parasuis* with 99% confidence (12).

The cotton tip of a transport culturette (CanLab, Toronto, Ontario), was inserted to a depth of about 2 cm in the nostril and then placed into the medium which consisted of modified Stuart's bacterial transport media. All swabs were plated within 6 h of sampling, onto chocolate agar containing 1.5 μg/mL lincomycin (Gibco Canada, Burlington, Ontario), 5 μg/mL bacitracin (Aldrich Chemical, Milwaukee, Wisconsin) and 0.1 μg/mL crystal violet (Sigma Chemicals, St. Louis, Missouri). A small amount of nasal material was spread with a sterile swab so as to completely cover the agar surface. A swab soaked in 1% nicotinamide adenine dinucleotide (NAD) (Sigma Chemicals, St. Louis, Missouri) was applied diametrically across the plate. All plates were incubated at 37°C, in normal atmosphere with 5% CO_2 for a maximum

TABLE 2
Total boar mortality at the Ontario ROP Boar Test Station from 1983–1985 by disease and health classification

	1983			1984			1985			
Disease	B	G	E	B	G	E	B	G	E	Total
Gastric ulcer	2	3	2	6	1	2	6	10	4	36
Polyserositis-polyarthritis	3	4	1	1	2	1	0	2	3	17
Porcine stress syndrome	2	1	1	3	3	1	0	5	0	16
Pneumonia	3	1	0	2	1	0	1	2	4	14
Campylobacter infection	0	0	1	0	0	0	0	4	0	5
Skin lesions (unspecified)	0	0	0	0	5	0	0	0	0	5
Spinal abscess	0	0	0	0	1	0	0	2	0	3
Intestinal accident	0	0	0	2	0	0	0	0	1	3
Streptococcus suis septicemia	0	0	0	0	0	1	0	0	0	1
Total	10	9	5	14	13	5	7	25	12	100
Total # Tested	1285	619	264	689	629	226	579[a]		619	268

B = basic G = good E = excellent

[a]For 1985, the total tested figures are only available for the Excellent category and for Basic and Good categories combined

of 60 h. Colonies showing enhanced growth adjacent to the NAD streak were subcultured and identified. Nonhemolytic, gram-negative rods which required NAD for growth, and which were urease and mannitol negative and α-fucocidase positive were recorded as *H. parasuis*. Four plates were incubated per nasal sample to increase the chance of isolating *H. parasuis*. Pigs were classified as carriers if *H. parasuis* was isolated from any plate. Herds were classified as infected if one or more pigs were positive for *H. parasuis*.

Results

Postmortem survey

During 1974–1984, 23,441 pig submissions were presented for necropsy to the laboratories involved in this study. The total number of suspected and confirmed Glasser's disease cases can be found in Table 1. Over the 11 year period, the losses due to Glasser's diseases represented less than 1% of the total swine submissions for each laboratory.

Although clinical signs were not always recorded fully for each pig, they included: lameness (6/42), recumbency (9/42), unthriftiness (9/42), excessive squealing (4/42). In 20/42 of the cases, no clinical signs were observed or noted prior to death.

The lesions described at necropsy were consistent with polyserositis and polyarthritis, with considerable variation in lesion severity. Lesions were most often found in combination and included: arthritis (62%), peritonitis (76%), pericarditis (74%), pleuritis (74%), and meningitis (45%).

Test Station Mortality 1983–1985

The cause of death in boars lost at the Ontario ROP Boar Test Station as related to health classification of the herd of origin is summarized in Table 2. The mortality rate at the station was equal to or less than 0.03% for each of the years studied. Polyserositis-polyarthritis was the second most common cause of mortality in the test station boars (Table 2). There was no significant association between health status and losses due to polyserositis, pneumonia, gastric ulcers or porcine stress syndrome (PSS) when the herd health classification of Basic, Good and Excellent were used for comparison. However, when SPF versus non-SPF herds were compared against the major causes of mortality (Table 3), losses due to polyserositis-polyarthritis were significantly associated with SPF health status of the herd of origin ($p = 0.05$). Only 17% of these cases were culture positive for *H. parasuis*, however, other organisms such as *Streptococcus* spp. or mycoplasma were not recovered from the *H. parasuis* culture negative cases.

Prevalence of H. parasuis in Excellent SPF herds

Of the 19 Excellent SPF herds studied, three herds were negative for *H. parasuis* and 16 herds were positive. The average number of culture-positive pigs per herd was 6/10 for positive herds.

TABLE 3
Major causes of mortality in SPF and non-SPF boars at the Ontario Boar Test Station, 1983–1985

	SPF	Non-SPF	Total
Gastric ulcers	8	28	36
Porcine stress syndrome	2	14	16
Pneumonia	4	10	14
Polyserositis (Glasser's disease)	16	1	17
Total	30	53	83

The negative herds were primary SPF operations which maintained strict isolation procedures and where all visitors were required to shower prior to entering the barn. On the 16 positive farms, clean coveralls and boots were provided for any visitors wishing to enter the pig barn but showers were not required. It was not possible to further explore other important factors which might lead to herd infection with *H. parasuis*, due to the small number of negative herds available for comparison.

Discussion

This study provides the first estimation of the occurrence of Glasser's disease in the general swine population as well as the prevalence of *H. parasuis* in "Excellent" SPF herds in southern Ontario. Often, outbreaks resembling Glasser's disease are not confirmed bacteriologically because the causative organism is fragile and difficult to isolate under routine conditions (13,14). Nonspecific clinical signs such as sudden death, poor performance and reluctance to rise are not indicative of any particular disease or cause of mortality. Thus, it is possible that the incidence of Glasser's disease in swine in southern Ontario is higher than this study might suggest. Where the clinical signs and bacteriological results are inconclusive, a history of recent exposure of SPF pigs to conventional animals may be helpful in formulating a presumptive diagnosis of Glasser's disease. This is exemplified by the high incidence of polyserositis-polyarthritis in SPF pigs brought to the ROP Boar Test Station and it is tempting to postulate that many of the *H. parasuis* culture negative cases were also Glasser's disease. The histories provided for the 11 year retrospective survey were not detailed enough to establish the health status of the herd of origin for most of the animals examined.

The gross postmortem lesions recorded in this study are similar to those reported by Nielsen and Danielsen (7). Although many animals were found to have a combination of lesions, in some instances only single or mild lesions were seen at necropsy. One would expect that the number of differential diagnoses would increase in the latter case. It was not possible to evaluate which tissues when cultured would provide the best source for retrieving *H. parasuis*, due to the variation among laboratories in selection of tissues for culture and possibly their ability to successfully cultivate the organism.

Animals from SPF herds had a significantly higher risk of acquiring polyserositis-arthritis at the Boar Test Station. Despite the fact that many of these could not be confirmed bacteriologically, we believe that these lesions were attributable to Glasser's disease. The same observation was made by Baehler *et al* (16) and Nielsen and Danielsen (7) when SPF animals were mixed with conventional animals at fattening facilities where the polyserositis could not be confirmed bacteriologically as Glasser's disease yet no other causative organism was present on culture. Similar situations are described repeatedly in the literature (14,15). The single case of polyserositis observed among the conventional boars suggests that polyserositis is not generally a problem associated with these animals when exposed to pigs from other farms (Table 3). Our study has summarized only mortalities attributed to polyserositis-arthritis, possibly Glasser's disease, and it is possible that the actual morbidity is higher than the recorded figures would indicate for the following reasons: animals showing signs of disease can be successfully treated with antibiotics, and producers may administer long-acting antibiotics to animals before they are sent to the test station.

The finding that only three SPF herds were negative for *H. parasuis* invites speculation as to how herds become infected if strict isolation procedures are followed. Since outbreaks of Glasser's disease usually begin in those animals which are in close proximity to the source of infection (15), it is likely that aerosol transfer is important for the transmission of *H. parasuis*. However, in cases where primary SPF herds become infected, it might be that transmission of *H. parasuis* has occurred from other than pig-to-pig contact. Since this organism can be transferred in fresh manure of conventional pigs (9), other possible mechanisms of transfer of *H. parasuis* might include: movement of pigs to improperly sanitized surroundings, proximity of SPF barns to conventional facilities allowing airborne transfer, rodent migration, or failure to ensure that strict entry procedures are followed.

In conclusion, our study provides evidence that cesarean-derived or secondary SPF pigs could be at greater risk of acquiring Glasser's disease when mixed with conventionally raised swine. Further study is required to determine if pigs from subclinically infected SPF herds have greater resistance to Glasser's disease than *H. parasuis* negative SPF pigs, upon first exposure to conventionally raised swine.

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Résumé

Environmental Source of Mycobacteriosis in a California Swine Herd.

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De juillet 1985 à avril 1986, les auteurs ont diagnostiqué six cas de lymphadénite à mycobactéries, parmi 2407 porcs issus d'un troupeau commercial dont la majorité étaient gardés à l'intérieur. Les dossiers révélèrent que les six porcs affectés s'étaient retrouvés dans des parcs à plancher en terre battue, pour au moins 81 jours avant l'abattage. Le taux de lésions de mycobactériose, chez les porcs gardés dans des parcs à plancher en terre battue, atteignit 9,4 %; il s'avéra toutefois nul chez les autres. Une expérience spéciale servit à déterminer le risque inhérent au déménagement de porcs gardés dans des parcs à plancher en béton, dans des parcs à plancher en terre battue. Cette expérience permit de constater que cinq des 15 sujets des deux portés déménagées dans des parcs au plancher en terre battue, à l'âge de 12 à 24 jours, dévellopèrent des lésions de mycobactériose, contrairement au 32 sujets des neuf portées témoins. On recouvra des mycobactéries du complexe *Mycobacterium avium*, chez neuf des 15 sujets des deux portées déménagées dans des parcs au plancher en terre battue, mais chez aucun des neuf portées témoins. Les sérovars des mycobactéries du complexe *M. avium* recouvrés chez les porcs infectés incluaient les suivants : 1, 4, 8, 9, le double sérovar 4/8 et un non typable. L'écorce du cèdre à encens (*Calocedrus decurrens*) qu'on utilisait comme litière, s'avéra une source potentielle du sérovar 9. L'isolement du double sérovar 4/8 et du sérovar non typable se fit à partir des parcs à plancher en terre battue. On ne décela aucune évidence d'une transmission croisée des mycobactéries du complexe *M. avium*. L'allure sporadique de la mycobactériose enregistrée dans ce troupeau résultait probablement d'une exposition non fréquente à une source environnementale commune.

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