Lymphosarcoma in three pigs in a multiple-site production system in Ontario

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Summary
This case study describes three sudden deaths in a multiple-site swine production system in Ontario between March 2003 and May 2004. All cases involved pigs < 7 months old with a common genetic background. On the basis of laboratory results, all cases were diagnosed as lymphosarcoma. The possible causes and significance of this disease in swine are discussed.

Keywords: swine, neoplasm, lymphosarcoma

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Resumen – Linfosarcoma en tres cerdos en un sistema de sitios múltiples en Ontario

Este caso describe tres muertes repentina en un sistema de producción de cerdos con centros múltiples en Ontario entre Marzo 2003 y Mayo 2004. Todos los casos involucraron cerdos con menos de 7 meses de edad y con una historia genética común. En base a los resultados de laboratorio, todos los casos fueron diagnosticados como linfosarcoma. Las causas posibles y la relevancia de esta enfermedad están siendo discutidas.

Resumé – Lymphosarcome en trois porcs dans un site de production de porcs avec sites multiples

Ce cas d’étude décrit trois morts soudaines dans un site de production de porcs avec sites multiples à Ontario entre Mars 2003 et Mai 2004. Tous les cas impliquent porcs de moins de 7 mois d’âge avec une génétique commune. Sur les bases de résultats de laboratoire, toutes les cas ont été diagnostiquées comme lymphosarcome. Les causes possibles et l’importance de cette maladie dans les porcs sont discutées.

All production sites received routine herd health visits, and standardized health protocols were implemented in each barn. Apart from clinical signs of Haemophilus parasuis infection in several of the nurseries, health was very good in all barns. Pigs were necropsied only if dead animals were present during a farm visit or if there were abnormally high losses during any period.

The pigs in the barns under study were from Mycoplasma-negative sources and had a common genetic background. The piglets farrowed in Barn C were raised to market in a number of finishing barns, including Barn A. Pigs in Barn B were farrowed in a different sow herd, but replacement animals for that herd came from the same breeding stock company that supplied gilts to Barn C.

In March 2003, in one 24-hour period, three 19-week-old Large White × Landrace × Duroc barrows were found dead in Barn A, a finishing barn housing approximately 2000 pigs. Necropsies were performed on the animals, which had appeared clinically normal on the previous day. In one pig, a solid mass was attached to the heart base and the liver had a mottled appearance. Tissue samples (fresh and fixed) were submitted to the Animal Health Laboratory, University of Guelph, Guelph, Ontario, Canada (AHL). On microscopic examination, the mediastinal lymph nodes and liver were densely infiltrated with a relatively uniform population of neoplastic lymphocytes. A diagnosis of lymphosarcoma was made. Similar lesions were not observed in the other two pigs and their deaths were attributed to other causes.

In June 2003, a 21-week-old Large White × Landrace × Duroc gilt was found dead in Barn B, a finishing barn housing approximately 1000 pigs. This animal also appeared clinically normal prior to death, and a necropsy was performed. There was significant splenomegaly (five to six times normal size), and numerous white nodules, 0.5 to 1.0 cm in diameter, were present in
Lymphosarcoma is the most commonly encountered neoplasm in pigs, followed by nephroblastoma and melanoma. There is no evidence of sex or breed predisposition. Diagnosis in the live animal is often difficult, as clinical signs (anorexia, dyspnea, and ataxia) mimic those of other diseases. Conversely, there may be no clinical signs, and if the animal survives, the condition is diagnosed only at slaughter.

Most cases of lymphosarcoma in swine are multicentric, characterized by enlargement of the lymph nodes and infiltration of various organs with neoplastic lymphocytes. The thymic form, in which the tumor originates at the thoracic inlet, has also been described in swine. In both types, multiple organs, most commonly the liver, spleen, and kidneys, may be infiltrated with neoplastic lymphocytes. Lymph nodes are often enlarged, and normal architecture may be completely replaced by homogeneous sheets of neoplastic lymphocytes. The spleen is enlarged and friable, with numerous bulging, pale nodules composed of neoplastic lymphocytes on its cut surface. In the liver, infiltrating lymphocytes may form distinct nodules (Figure 1), or the cells may be loosely scattered through stromal tissue. Tumor cells may appear as single homogeneous gray-white nodules in the kidneys, or as diffuse infiltrates that cause nephric enlargement.

Occasionally, lesions are found in other tissues, such as skeletal muscle and bone marrow.

Arendz reported that, with minor exceptions, suspected cases of lymphosarcoma cannot be diagnosed grossly in slaughter hogs (Dr J. Arendz, written communication, 1988, provided by S. Frazee, Canadian Food Inspection Agency, 2004). In that study, only 49 of 104 suspected cases (47.1%) were confirmed by microscopic examination. The remaining cases were either lymph node hyperplasia or lymphadenitis. Conversely, cases involving only one lymph node may not be detected at slaughter.

Porcine neoplasia is probably caused by an interaction of infectious, hereditary, and environmental factors. Viruses are recognized as agents of neoplasia in several species of domestic animals, eg, avian leucosis virus, bovine leucosis virus, feline leukemia virus, and porcine lymphoma C-type particle (PLCP), an oncornavirus related to feline leukemia virus. Busse et al investigated the possibility that swine lymphosarcoma is caused by porcine lymphoma C-type particle (PLCP), an oncornavirus related to feline leukemia virus. However, after testing sera from normal, affected, and experimentally infected animals, these investigators concluded that PLCP is an exogenous retrovirus and is probably not the cause of swine lymphosarcoma.

**Discussion**

Examination of slaughter data allows an assessment of the significance of disease conditions in young pigs. Neoplasms account for only a small portion of carcass condemnations in swine. Slaughter data collected from abattoirs in Ontario for the period January 1 to July 16, 2004, indicated that 0.02 to 0.10 carcasses per 10,000 hogs slaughtered were condemned for lymphosarcoma (Dr J. Arendz, written communication, 2004; D. Roguel, Canadian Food Inspection Agency, written communication, 2004). In the production system under discussion, for the period January 1 to July 16, 2004, two carcasses of 186,480 hogs slaughtered, or 0.11 carcasses per 10,000 hogs slaughtered, were condemned for lymphosarcoma (Ontario Pork Producers’ Marketing Board, Guelph, Ontario, Canada, written communication, 2004).

Many pigs that die are never necropsied; therefore, it is difficult to determine the true prevalence of neoplasms in swine. In the years 1991–2003, 28 cases of lymphosarcoma, four cases of nephroblastoma, and six cases of melanoma were reported among AHL submissions of pigs < 1 year old (AHL database). These represented 0.1%, 0.014%, and 0.021%, respectively, of the total swine submissions in that period.
Koller et al.\textsuperscript{10} attempted to transmit bovine lymphosarcoma virus to swine by feeding colostrum and neoplastic tissues from infected cows to specific-pathogen-free piglets. There was no evidence of lymphosarcoma in any of the 42 pigs when they were slaughtered at ages ranging from 6 to 9 months.

Unlike the adult form of bovine lymphosarcoma, which is caused by bovine leucosis virus, porcine lymphosarcoma is usually a sporadic disease.\textsuperscript{11} However, McTaggart et al.\textsuperscript{12} reported on a herd of Large White pigs in Scotland in which the disease appeared to be associated with an autosomal recessive gene. All cases occurred in offspring from the matings of three boars and seven sows with common ancestry, and the disease occurred as early as 6 to 12 weeks of age. The disease pattern was constant but developed at various rates in different animals.\textsuperscript{13} A breeding program using descendants of one boar was established in order to determine if the lymphosarcoma was of a heritable nature.\textsuperscript{13,14} Matings of nondescendants with descendants resulted in the appearance of 33 cases of lymphosarcoma among the 208 offspring. In matings between nondescendants, no cases of lymphosarcoma were observed in 808 offspring.\textsuperscript{13} Since affected animals died before reaching sexual maturity, it was not possible to mate affected males with affected females in order to prove the recessive nature of the disease.\textsuperscript{12} There have been no other reports of multiple-incidence herds, presumably because there have been no other examples of detailed investigation.

In both the sporadic and inherited forms of lymphosarcoma in swine, grossly and microscopically similar lesions occur in the same organs, and most affected animals are < 12 months old.\textsuperscript{11} Chemicals are responsible for the largest proportion of human cancer cases; however, the importance of environmental chemical exposure as a cause of cancer in domestic animals is largely unknown.\textsuperscript{15} Dioxins and polychlorinated biphenyls, halogenated aromatic compounds which are environmentally persistent and which accumulate in body fat, are considered by the US Environmental Protection Agency to be probable human carcinogens.\textsuperscript{16} Animal feed may be an important source of these compounds.\textsuperscript{17} Cases of contamination of livestock feeds are generally isolated. Bedding and water may also be contaminated.

At this time, it is not possible to state with any degree of certainty whether cases of swine lymphosarcoma are more likely to be genetically linked, chemically induced, or caused by a viral agent. Further investigation will be necessary to confirm this. The low incidence of this condition and the fact that it is not an economically significant disease in swine production are likely to preclude any rapid developments in this area.

**Implications**

- Histological examination is required to confirm cases of lymphosarcoma in hogs at slaughter.
- Correlation of lymphosarcoma with hereditary factors, viral infection, chemical carcinogens, or combinations of all three has not been established.
- As lymphosarcoma is probably largely undiagnosed in the general swine population, it is not possible to determine the significance of three cases in this production system.
- The low incidence of swine lymphosarcoma and its lack of economical significance are likely to preclude further investigation into its etiology.

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**References**

17. *Non-refereed references.