# 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 repentinas 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 décris trois morts soudaines dans un site du système 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'age avec une génétique commune. Sur les bases de résultats de laboratoire, toutes les cases ont été diagnostiquées comme lymphosarcome. Les causes possibles et l'importance de cette maladie dans les porcs sont discutées.

Neoplastic diseases have not been widely studied in pigs, although prevalence in slaughter animals has been recorded in several countries in the past four decades. Since most swine are slaughtered at 6 months of age or younger, the most common tumors diagnosed are those that commonly occur in young animals, ie, lymphosarcoma, nephroblastoma, and melanoma.[1] Lymphosarcoma is a general term applied to malignant neoplastic disorders of lymphoid tissue.[2] Malignant tumors often grow rapidly and are invasive, but may or may not be metastatic.

This study describes three cases of lymphosarcoma that occurred in a multiple-site production system in southwestern Ontario in a 14-month period.

## Case descriptions

The barns were located 15 to 60 km apart and were owned by individual producers who were responsible for the labor and maintenance in each barn. All barns had fully-slatted floors, and bedding was not used. The pigs in Barns A and C were owned by one company and received feed from the same mill, and pigs in Barn B were owned by a second company, which obtained feed from a different mill. All barns were contracted under a single production management system.

The sow herds in the system were vaccinated against porcine reproductive and respiratory syndrome (PRRS) virus and *Mycoplasma hyopneumoniae* because of the high prevalence of both diseases in the region. Piglets were weaned at 14 to 17 days of age and remained free of PRRS virus infection in the nursery and finisher barns.

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

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the pericardium, liver, kidney, duodenum, and spiral colon. Fixed tissues were submitted to the AHL. Microscopic examination indicated that all tissues were infiltrated with sheets of neoplastic lymphocytes. A diagnosis of widely disseminated lymphosarcoma was made.

In May 2004, a 6-month-old Large White × Landrace × Duroc gilt was found dead in Barn C, the isolation barn of a 2500-sow farrow-to-early-wean commercial herd. There had been no evidence of disease in any of the other 39 gilts during the 2-week period that they had been housed in the facility. At necropsy, the lungs were moderately edematous and mottled in appearance. The hepatic lymph nodes were markedly enlarged to approximately 30 times normal size. Fixed tissues were submitted to the AHL. On microscopic examination, large monotonous sheets of neoplastic lymphocytes had replaced the normal architecture of the lymph nodes, and neoplastic lymphocytes were present in many small vessels in the lungs. A diagnosis of lymphosarcoma was made.

## 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 years 1996–2003 indicated that 0.02 to 0.10 carcasses per 10,000 hogs slaughtered were condemned for lymphosarcoma (D. Hayward and F. Azim, Canadian Food Inspection Agency, oral communications, 2004; D. Roguel, Canadian Food Inspection Agency, written communication, 2004).[3] 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.

Lymphosarcoma is the most commonly encountered neoplasm in pigs, followed by nephroblastoma and melanoma.[4] 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.[5] 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.[6] 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.[5] 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 homogenous gray-white nodules in the kidneys, or as diffuse infiltrates that cause nephric enlargement.[7]

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.[8]

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. Busse et al[9] 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 endogenous retrovirus and is probably not the cause of swine lymphosarcoma.

**Figure 1:** Lymphosarcoma in a market-age pig, showing nodular infiltration of the liver.

Koller et al[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.[11] However, McTaggart et al[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.[13] A breeding program using descendants of one boar was established in order to determine if the lymphosarcoma was of a heritable nature.[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.[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.[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.[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.[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.[16] Animal feed may be an important source of these compounds.[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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