Chromosomal aberrations seen in swine lymphomas

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Swine lymphoma (malignant lymphoma, lymphosarcoma) is usually found in the postmortem inspection of meat hygiene by veterinarians. The rate of frequency of this condition is believed to be one to two cases per 100,000 slaughtered pigs in the many developed countries. There have been a considerable number of papers describing anatomical, histopathological and cytopathological characteristics of the disease, including some cell lineages, but there were few papers on hematology, chromosome aberrations of neoplastic cells, and stages among lymphoma cases of this species. There have not been any papers on chromosome analysis of a considerable number of series.

In the present study, the author developed a new chromosome preparation technique for pigs and carried out chromosomal analyses on 50 cases out of 138 pigs with lymphomas detected in the routine meat inspection and examined histopathologically in Miyagi Prefecture locating in the northern-east of JAPAN, during 1977 to 2005.

Development of a new chromosome preparation technique for pigs.

In the early stage of the present study, the author employed a standard cultural method for obtaining chromosomal samples in slaughtered pigs. The author developed a direct chromosome preparation technique for swine, because it was necessary to decrease false positive results in detecting a chromosome abnormality by the culture method. This direct chromosome preparation technique decreased the false chromosome abnormality and gave suitable specimens even in the unfavorable circumstances as in the local meat hygienic inspection office. Using this method based on an appropriate hypotonic treatment of targeted cells in the refrigerator, the author succeeded to obtain chromosome specimens from blood and neoplastic tissues taken within two hours and processed within 12 hours after slaughter.

The ratio of normal karyotype of peripheral blood sample obtained by culture methods with or without PHA, and a direct preparation were 84.2%, 73.2%, and 96.3%, respectively. The results were similar in blood samples taken from axillary vein of the carcass.

Results of chromosome analysis of cells in the blood samples:

(1) Abnormality in chromosome number was present in about 70% of chromosome samples prepared by culture method without PHA, about 60% of culture method with PHA, and about 40% of new direct technique among blood samples of swine lymphoma cases.

(2) Chromosome aberrations seen in the cultured blood samples were four non-clonal abnormalities, and nine clonal abnormalities. Clonal abnormalities were sub-classified into two deficient types, three additional types, two examples of overlapped deficient and additional types, one example of overlapped additional and translocation types and one example of overlapped translocation and deficient types.

(3) By new direct preparation technique, the chromosome aberration was seen in eight multicentric, one alimentary, and one miscellaneous type swine lymphoma. Based on chromosome analysis, eight multicentric type swine lymphomas were divided into three non-clonal, and five clonal examples. Clonal abnormalities were two additional types, two translocation types, one deficient or additional type, and one partial deficient type. One alimentary and one miscellaneous swine lymphomas were non-clonal abnormality.

Results of chromosome analysis of tumor cells:

Chromosomes of 16 multicentric swine lymphomas were composed of two normal karyotypes, three non-clonal abnormalities, and 11 clonal abnormalities. Clonal abnormalities were one deficient type, four additional types, three translocation types, one partial additional type, one partial deficient type, and one translocation-euploid type.

Eleven cases of alimentary swine lymphoma included three normal karyotypes, five non-clonal abnormalities, and three clonal abnormalities. Clonal abnormalities were subdivided into one deficient type, one deficiency and additional type, and one euploid type.

Three thymic type swine lymphomas were one normal karyotype, and two clonal abnormalities: additional type overlapped with partial deficient and one translocation overlapped with partial deficient type.

Four miscellaneous cases of swine lymphomas were two normal karyotypes, one non-clonal abnormality, and one clonal abnormality of translocation type.

Type of swine lymphoma and chromosome aberration:

Present study failed to reveal the characteristic chromosome aberration of any type of swine lymphoma according to clinico-pathological classification proposed by Jarrett and Mackey and LSG classification developed and used in Japan.

Cells with "normal karyotype" pattern and non-clonal abnormality were rather small in number and seemed to remain in the first stage of alteration. These abnormal cells with minimal chromosome changes were not distinguished from the apparently healthy pig cases. The chromosome aberration seemed to progress from the first single aberration to double, or more complicated ones. The degree of chromosome aberrations seemed to agree well with the stage and the nature of the disease. In 80% of swine lymphoma cases diagnosed pathologically, neoplastic cells showed chromosomal abnormalities in the number and morphology caused by chromosome nondisjunction, spindle body suppression, chromosome bonding, chromosome hyperplasia, *etc.* Always, the cells with chromosome aberration existed together with normal cells, and the ratio varied both in tissues and blood.

On the other hands, cells with clonal abnormalities, which turned into cancer cells, proliferated explosively. Cancer cells with clonal abnormalities showed multistep alterations in chromosome both in number and shape interpreted as single or complicated chromosome aberrations, so-called "karyotype evolutions". Steps of karyotype change seemed to require various periods of time. In the early stage, it needed rather long time, because the many barriers such as immune system and apoptosis of the living body were considered to suppress these abnormal cell growths, but after onset of detectable cancerous change, chromosome abnormalities

seemed to develop rapidly according to the disease progression.

In chromosome analyses of blood sample, 70% of specimens had the same abnormality as in those of neoplastic tissues. However, in swine lymphoma cases with slight or minimal gross lesions, blood contained few neoplastic cells and leukemic change might be a terminal change after or coincident with development of widespread gross lesions.

In conclusion, swine lymphoma cases showed abnormal changes in chromosomes with karyotype evolution. It was possible to interpret the stage and severity of the disease, when one introduced the karyotype analysis as one of routine examination methods in addition to observations of anatomical types, distribution of neoplastic lesions, and cellular morphology.