Congenital Porphyria in Swine

Chie YAMASHITA, Hideo SHIMAZAKI, Tsutomu MIYAKE and Masashi SAITO

Tama Meat Inspectors Station, Bureau of Public Health, Tokyo Metropolitan Government, Fujimi-cho, Tachikawa-shi, Tokyo 190

Yurio SAHEKI and Ruizo ISHITANI

Department of Veterinary Pathology, Faculty of Agriculture, Tokyo University of Agriculture and Technology, Saiwai-cho, Fuchu-shi, Tokyo 183

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Abstract. Fourteen cases of swine porphyria were collected at a slaughter house in Tokyo, and investigated clinically and pathologically. All animals were born from a boar of Duroc race, indicating or suggesting occurrence by a Menderian recessive factor. All the cases had delay of growth, anemia and porphyrinuria. Chocolate-brown discoloration occurred markedly or moderately in the bones, bone-marrow, liver, spleen, lung, kidney, adrenal cortex, medullary cord of lymph node and anterior lobe of pituitary gland, which gave red fluorescence under ultraviolet light. Histopathologically, the deposition of porphyrin granules were mainly observed in reticuloendothelial cells of these discolored organs and epithelial cells as well as hyaline casts within renal tubules. Extramedullary hematopoiesis was present focally in the spleen, liver, kidney and adrenal gland, and degeneration was observed in liver cells and renal epithelial cells.

Porphyria or osteo-hemochromatosis [12] is a disease characterized by the metabolic defect of the porphyrin bodies which distributed widely in animal and plant tissues and are important for constitution of hemo-proteins and cytochromes. This disease rarely occurs in domestic animals and has been described in cattle [2, 4, 7–13], swine [1, 6, 9] and cat [4]. Porphyrias of fox squirrels was also reported [3]. In Japan, 2 cases of porphyrionic cattle were described by Ezaki et al. [2], while no reports in swine.

This paper deals with clinical and pathological findings with 14 consanguineous cases of swine porphyria, which were detected in Tama Meat Inspectors Station in Tokyo Metropolitan Government.

Materials and Methods

Fourteen cases of swine porphyria were obtained at a slaughter house of Tokyo Metropolitan Government in the period from June 1978 to February 1979. They were 7 males and 7 females, about 6 months in age. Their father and grand father were of Duroc and Large White races, respectively.

Two of 14 cases were detected clinically but others were by post-mortem examination. After the post-mortem examination including exposure to ultraviolet ray, tissue specimens were collected from the liver, spleen, kidney, lung, adrenal gland, thyroid gland, pituitary gland, brain, stomach, intestine and lymph nodes and fixed with 10% buffered-formalin solution. Then paraffin sections were prepared, and stained with hematoxylin and eosin (HE), Azan and periodic acid Schiff (PAS). Fontana’s silver staining and iron staining were also made. Furthermore, deparaffinized unstained sections were examined under the ultraviolet light microscope.

For the quantitative analysis of porphyrin, Bruschi-Fischer’s method was applied to the samples of urine, bile and blood from one case.

Results

1. Occurrence and clinical features
All the porphyric animals were from a boar of Duroc race raised in Motosayama area, Tokyo, and their dams were of the hybrid of Large White and Landrace. The grandfather of three sows was of Large White race while the remainings were of unknown origin (see Fig. 1). About 200 heads were produced by the Duroc boar and the dams, and 14 of them had porphyria. Patients Nos. 1–3, 7, 9, 11 and 14 in Fig. 1 were females, and others were males. It is possible that patients Nos. 1–4, 6 and 7 produced from Iwata Farm were of the same litter. Patients Nos. 8, 9 and 10 from Ikeya Farm were of a litter of 10 heads. The dams of patients Nos. 11, 12 and the parents of No. 13 were unknown, but all of them were produced in Motosayama area. The Duroc boar was soon sacrificed because of insufficient reproductive performance. Clinically and pathologically the symptoms and lesions suggesting porphyria were not observed in the boar.

In the porphyric animals, there were varying degree of growth delay, excretion of reddish-brown urine (Fig. 2) and severe anemia with anisocytosis, poikilocytosis and appearance of the polychromic erythrocytes and erythroblasts (Fig. 1). A low hematocrit value of 13.5% was revealed in one case. The photosensitive skin lesions were not observed in any case.

2. Pathological findings

Grossly, chocolate-brown discoloration was remarkable in the bones (Fig. 4), bone-marrow, liver, spleen (Fig. 6), lung, kidney (Fig. 3), adrenal cortex, medullary cord of lymph nodes and anterior lobe of pituitary gland. The degree of discoloration varied according to the cases. Slight brown coloration of the alimentary tract and adipose tissue found only in severe cases. “Pink tooth” was not remarkable, but the dentin showed also chocolate-brown colour. All these colored bones, teeth and organs gave a fine red fluorescence under the 3650 Å ultraviolet light (Fig. 5). No cartilage, ligaments, tendons, periosteum and muscles showed such fluorescence.

As porphyrin pigment was dissolved slightly in water, specific colour was diminished often in bone samples which had been immersed in water.

Microscopically lesions were prominent in the bone-marrow, liver, kidney, adrenal gland, lung, and lymph nodes. In the bone-marrow, erythroblasts increased in number containing a large amount of porphyrin. Also the reticuloendothelial cells had a lot of brown porphyrin granules (Fig. 7). In the liver, Kupffer cells and sinusoid endothelial cells were activated containing a large quantity of brownish granules of porphyrin and hemosiderin. The liver cells showed slightly degenerative change. The small foci of extramedullary hematopoiesis was observed in liver lobules, Glisson’s sheath as well as spleen. Large amount of porphyrin granules were present in the
reticuloendothelial cells of the spleen (Fig. 9), while hemosiderin granules were very rare. In the kidneys, brown porphyrin pigments were present in histiocytic cells, epithelial cells and hyaline casts within renal tubules (Fig. 10). Mesangial cells were enlarged, the epithelial cells of renal tubules showed slightly degenerative change, and the tubular spaces were narrowed containing casts. Extramedullary hematopoiesis were present focally in the interstitium.

In the adrenal cortex, capillary endothelial cells contained many porphyrin granules. The lung showed activation of reticuloendothelial cells and porphyrin and hemosiderin granules were seen in the cells of alveolar septum. In the brain of one case, a calcified lesion of 8 mm in diameter was observed and there were small glial nests in the white matter of thalamencephalon. In the skin of one case, there was remarkable thickening of epidermis and codium with a lot of scurf detected, where *Sarcoptes* spp. parasitized. The skin showed irregular arrangement with proliferation of fibroblasts in the subcutaneous tissue, thickening of the media of small blood vessels, and infiltration of lymphocytes, plasma cells, eosinophiles and neutrophiles. In the lymph nodes, follicles were usually small in size, and the medullary cords slightly increased in width. Reticuloendothelial cells contained brownish porphyrin granules.

The porphyrin granules in each organs showed the following staining characteristics; iron (−), PAS (±), Fontana’s silver (+), and red fluorescence under 3650 A ultraviolet light (Fig. 8). There were no lesions in the bladder.

3. Chemical findings

In all cases a large amount of porphyrin was detected in urine, bile, blood samples as well as organ extracts. Case No. 6, coproporphyrin amounts were of 899.65 µg/dl in urine, 1567.5 µg/dl in red blood corpuscles, and 1046.9 µg/dl in bile, δ-aminolevulinic acid amounts of 3.5 mg/dl in urine. In other 4 cases, coproporphyrin in bile was such remarkable value as 4937.6, 4460.1, 5047.0 and 4771.1 µg/dl, being about 50 times higher than normal levels.

No porphyrin was evidenced in blood, feces, and bile of the Duroc boar, nor in blood and feces of sows, Hasegawa-1 and Iwata-3. No porphyrin-inducing substances were demonstrable in feeds given the animals concerned.

**Discussion**

From the findings of the liver, Sasaki [14] classified human cases of porphyria into two types, porphyrias erythropoietica and hepatica. Porphyrnia erythropoietica was further subdivided into porphyria congenita (Günter), protoporphyrinia erythropoietica and coproporphyrinia erythropoietica. These porphyrin condition was suspected to occur by a Mendelian recessive factor and the present cases were considered to be porphyria congenita, according to Sasaki’s classification, being different from swine cases reported by Jørgensen [6] in the mode of hereditary transmission. In the present cases, however, all the patient animals were derived from one Duroc boar, but genetic analysis was impossible because the boar was sacrificed very early after the detection of illness in his offspring. The diseased descendants were also sacrificed early in their life but they were considered to be unable to live so long.

The growth delay, anemia, extramedullary hematopoiesis and slight degenerative changes in liver cells and renal epithelial cells, which were observed in the present cases, were not described by Jørgensen [6–9]. The deposition of hemosiderin was
marked in the liver and lung, and slightly in the spleen, suggesting compensatory changes for blood cell turnover. The other macroscopic and microscopic findings were almost similar to those reported by Jorgensen. In the swine porphyria reported by Clare and Stephen [1], no pathological changes were described.

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References

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Explanation of Figures

Fig. 1. Blood smear of a porphyric swine, showing poikilocytosis, anisocytosis and appearance of polychromic erythrocytes and erythroblast.

Fig. 2. Urine (left) and bile (right) from a porphyric swine.

Fig. 3. Porphyric kidney (above) showing chocolate-brown coloration, and normal kidney (below).

Fig. 4. Femoral, tibial and scapular bones of porphyric swine with characteristic coloration under day light.

Fig. 5. Same bone of Fig. 4, showing red fluorescence under 3650 A ultraviolet light.

Fig. 6. Spleens of porphyric (above) and normal (below) swine.

Fig. 7. Bone-marrow of porphyric swine, showing increased number of erythroblasts and reticuloendothelial cells containing porphyrin granules. HE staining, ×400.

Fig. 8. Bone-marrow under 3650 A ultraviolet light. Deparaffinized unstained section, ×400.

Fig. 9. Nests of extramedullary hematopoiesis scattering diffusely in the spleen. HE staining, ×50.

Fig. 10. Kidney of a porphyric swine having many brown porphyrin granules in epithelial cells and casts within renal tubules. HE staining, ×400.