

An Outbreak of Ibaraki Disease in Korea

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Introduction

An epizootic disease of cattle, Ibaraki disease resembling bluetongue was identified in Japan.^{11, 14, 18)} The disease of cattle swept over the central and western parts of Japan, the areas in the south of the 38th parallel during the months from August through December in 1959 and 1960.^{8, 9, 16, 17)}

Clinically the disease was characterized by fever, ulcerative stomatitis and dysphagia.^{8, 17)} A total of 39,076 cases were reported with a morbidity of 1.96 per cent, a mortality of 0.20 per cent and a case fatality of 10.3 per cent in the districts involved in the outbreak of 1959.^{8, 16, 17)} Japanese workers, Matsumoto *et al*,¹⁴⁾ Omori *et al*¹⁸⁾, Inaba *et al*¹¹⁾ isolated the causative virus from naturally and experimentally infected cattle and designated the virus as Ibaraki virus.

Outbreak of Ibaraki disease was not reported in countries other than Japan.^{8, 16)} But some data on an existence of cattle harbouring neutralizing antibody against the Ibaraki virus in Bali island of Indonesia and Taiwan were studied by Japanese authors.^{8, 17)}

From September to November in 1982, there occurred among cattle an epizootic of the disease which accompanied typical dysphagic symptom. By a

survey on the epizootic of the disease, clinical, epidemiological, pathological and serological studies, it was diagnosed as Ibaraki disease and presenting the first report on the epizootic in Korea.

Materials and Methods

The authors observed the epizootics of cattle disease characterized by dysphagia, dehydration and stomatitis by clinical and epidemiological means over the central district of Korea and other several districts around the central district during months from September to November.

Pathological examination: A total of four cattle were slaughtered with no hope of recovery from persistent dysphagia and dehydration and were submitted to pathological examination. After macroscopic observation of the organs samples were collected from the oral, laryngopharyngeal regions, esophagus, forestomach, abomasum, intestine, liver, kidney, spleen, heart and lung for histological examination. All samples were fixed in 10% buffered formalin, and prepared in to paraffin sections and stained with hematoxylin and eosin for microscopic observation.

Serological examination: The blood samples of the six cases were obtained from the four slaugh-

tered cattle affected with the disease and other cattle showing typical symptoms of the disease. Neutralizing antibodies in serum samples against Ibaraki virus were tested in primary bovine kidney cells as described by Omori *et al*¹⁸⁾ with minor modifications. The virus used in this test was supplied by National Institute of Animal Health, Japan and made three more passages in bovine kidney cells. In brief, serum was heated at 56°C for 30 min and made two fold serial dilution in tryptose phosphate broth starting at 1 : 20. Each dilution of serum was mixed with an equal amount of virus suspension containing 200 TCID₅₀ per 0.1ml and reacted at room temperature for 1 hr. The resulting mixtures were inoculated into 2 tube cultures of bovine cells in 0.1ml each. The inoculated cultures were incubated at 37°C.

The antibody titer was expressed as the reciprocal of the highest serum dilution which completely inhibited the appearance of cytopathic effect in at least one of the two cultures.

Results

Occurrence and clinical manifestation: The incidence of the disease was initially recognized in the central district of Korea, Gyongido province, in September of 1982 by the typical symptom of deglutitive difficulty. The disease tended to occur rather sporadically and continued until November of the year. The onset of the disease was recognized with fever up to about 41°C. The fever lasted for 2 or 3 days but it was lasted as long as 7 days or more in some cases. The predominant clinical signs were fever, anorexia, foamy salivation, rhinorrhoea, conjunctivitis and lacrimation, congestion or erosion of the oral, nasal mucosa and muzzle, and dysphagia. In many cases oral and nasal regions or muzzle appeared to be congestive mucosae occasionally with erosion and crust.

The outstanding symptom of the disease was dysphagia which was observed in most of the affected animals. The dysphagic sign developed 5 to 10 days after the onset of the fever when the initial symptom had subsided. The affected animal could swallow water but when the head of the animal

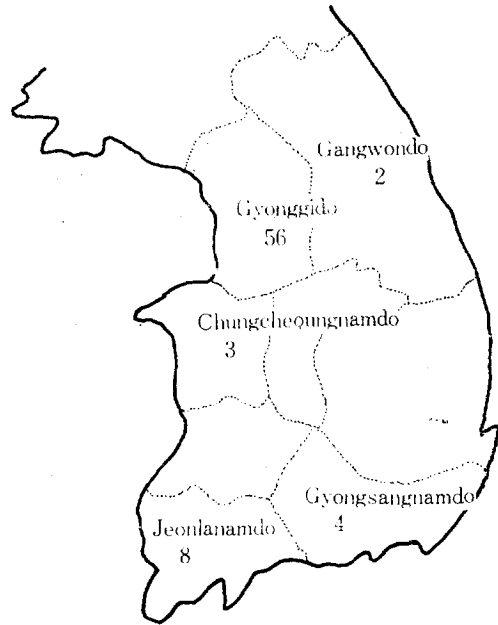


Fig. A. Local occurrence of Ibaraki disease in Korea in autumn, 1982. The indicated number of the cases was confirmed by typical dysphagic sign among cattle.

lowered the water contents of the esophagus flowed freely out of the nostrils and mouth (Fig. 1).

Generally the run of the disease was mild and animals recovered within 2 or 5 days. But prolonged dysphagic sign resulted in severe emaciation or occasionally led to aspiration pneumonia. A few cattle died due to the disease. The fatal cases were attributed to persistent dehydration or aspiration pneumonia. Most of the cases were young cattle less than 4 or 6 years of age.

The number of cases confirmed by typical dysphagic sign or onset of fever amounted to 73 cases in several districts. As shown in Fig. B outbreak of the disease was concentrated in Gyongido province. In other districts around Gyongido province, Chungcheongnamdo and Gangwondo provinces, and Jeonlanamdo or Gyongsangnamdo the disease tended to occur rather sporadically, as shown in Fig. A. The morbidity reached to 0.056 per cent of the total cattle population in the involved areas of Gyongido province.



Fig. B. Local occurrence of Ibaraki disease in Gyeonggi-do province in autumn, 1982. The indicated number of the cases was shown typical dysphagic sign.

Gross pathology: In the four culled cases from the infected cattle, the muzzle, gingiva, tongue, hard palates and nostril showed no conspicuous changes such as congestion, edema or ulceration, except small pieces of crusts on the dry surface of the muzzle or nares. The main gross lesions were found in the esophagus, abomasum or subcutaneous region. The dry or gelatinous appearance of the subcutaneous tissue was remarkable in the area of the thoracic inlet and along the fascial sheaths of the ventral structures of the neck and intermandibular space.

The wall of the esophagus of the affected animal was loose and dilated throughout the length of the organ. The esophageal musculature of some affected cases appeared as diffuse opacities or greyish mottling or streaks.

The food contents of the rumen and abomasum were dry with lack of fluid. The mucosa of the abomasum showed marked changes such as diffuse congestion, edema, hemorrhage or necrotic foci. The lesion of the abomasum revealed also thickened appearance with distinct folds and ulcerative

foci (Fig.4). In some cases, there were disseminated necrotic foci, each of them showing doughnut shape with central ulceration (Fig. 3). The lungs were enlarged, failed to collapse, and were diffusely reddened and moist occasionally with marked interstitial emphysema. The trachea and bronchial trees contained white or pinkish froth.

Microscopic findings: The cattle examined were all severely affected cases microscopically in the esophagus, larynx and pharynx which showed scarce gross lesion. The most striking changes in these organs were degeneration, necrosis and hemorrhage of the striated muscle. Muscle degeneration of the affected organs, mainly the esophagus, showed focal distribution involving multiple muscle fibers. In some part of the affected organ, a single fiber or a few fibers were degenerated among normal ones.

Usually affected portions of the muscle fibers and the muscle fibers of normal areas occurred alternately. The involved muscle fibers were showing more acidophilic staining than the normal ones, and the fibers were swollen, distorted, variable in size and hyalinized with loss of cross striation (Fig.5). In advanced degeneration, sarcolysis of muscle fibers was found to be pale, uneven in size, cavitated and broken apart (Fig.7). Occasionally calcific stippling of sarcoplasm of degenerated fibers occurred in some muscle lesions (Fig.7).

The sarcolemmal nuclei were usually intact, but were sometimes pyknotic. Usually interstitial space of muscle fibers were widened by edematous changes, furthermore there were many empty sarcolemmal spaces after disintegration of muscle fibers (Fig.8). The interstitial capillaries of muscle fibers were distended and frequently involved with hemorrhage (Fig.8). Infiltration of neutrophils was present around the degenerated muscle fibers and also lymphocytes and macrophages were found occasionally (Fig.8).

In more advanced lesions of the affected muscle fibers there were extensive proliferation of fibroblasts with infiltration of lymphocytes and macrophages (Fig.6). But both fresh and advanced lesions of the muscle tissue occurred in the same org-

Table 1. Neutralizing Antibody Against Ibaraki Virus in the Serum Samples of the Affected Cattle

| Serum No. | Specification | | Serum neutralizing antibody titer |
|-----------|----------------|-------------|-----------------------------------|
| | Breed | Age in year | |
| 1 | Japanese breed | 5 | 80 |
| 2 | Korean native | 6 | 20 |
| 3 | Holstein | 5 | —* |
| 4 | Holstein | 3 | — |
| 5 | Korean native | 4 | — |
| 6 | Holstein | 5 | — |

*: Antibody activity was not detected in serum dilution at 1 : 20.

an of individual case. These degenerative changes of the striated muscle fibers were also found in the laryngopharyngeal or lingual musculatures but with lesser extent than those in the esophageal lesions.

Serological findings: Neutralizing antibodies against Ibaraki virus in serum samples of the six cases collected in the enzootic area were tested in primary bovine kidney cells. As shown in Table 1 serum samples of the two cases showed significant positive titer of the antibodies against Ibaraki virus. Of the other cases examined antibody activity was not detected in serum dilution at 1 : 20.

Discussion

The epizootic cattle disease characterized with fever, ulcerative stomatitis and dysphagia was recognized in central district of Korea during months from September to November in 1982. In other districts the disease tended to occur sporadically with lower mortality.

In this survey on the disease, cases of the disease outbreak were recorded by confirming the animals showing typical symptoms such as fever and dysphagic signs. In several epizootics of the disease in Japan typical dysphagic sign appeared in 20 to 30 per cent of affected animals.^{8,16,17} Thus it was presumed that far more affected cases than the recorded number of the sick animals might occur in the epizootic area in Korea.

The obtained data including seasonal incidence of the disease outbreak, typical symptoms such as

dysphagia and oral or nasal signs were essentially similar to those reported in several epizootics of the disease in Japan.^{8,9,16,17} The gross lesions were observed mainly in the oral and nasal mucosae, esophagus and abomasum mucosa. Histological features, hyaline changes and hemorrhage of the striated muscle were obvious in the esophagus and laryngopharyngeal area. These gross and microscopic findings observed in the affected cattle were very similar to those reported by Sugano,²⁰ Goto⁵ and Ishitani¹² in Japan. The histological changes of skeletal muscle fibers in Ibaraki disease were also closely resemble to those in bluetongue of sheep reported by Moulton¹⁵ or Thomas.²¹ However, in bluetongue of sheep the skeletal muscle lesions did not occur in the esophagus but in the trunk and tongue. In cattle the infection of bluetongue is usually not apparent although it may resemble the disease in sheep.^{2,3} Cattle affected by bluetongue showed congestion and erosions in the muzzle, oral and nasal cavities like as Ibaraki disease but did not show degenerative change in the esophagus musculature.^{2,3} Thus degeneration of the esophageal musculature was designated as the principal lesion in Ibaraki disease to be differentiated from other infections such as bluetongue, ephemeral fever, and bovine viral diarrhoea-mucosal disease.

Japan was the only country where outbreaks of Ibaraki disease were reported^{8,9,16} up to date. And the data on existence of neutralizing antibody against the Ibaraki virus in Indonesia and Taiwan

were studied by Japanese workers.^{8,17)} It is presumable that Ibaraki virus is widely disseminated in tropical temperate zones and Japan and Korea represent the northern boundary of distribution of the disease.

Epidemiological and etiological studies on Ibaraki disease,^{8,9,16,17)} Akabane disease¹⁰⁾ and ephemeral fever⁷⁾ of cattle were fully studied in Japan. Japanese authors suspected that some tropical areas, such as Indonesia might be the original areas of these diseases with high antibody titers and no apparent infection in cattle, from which these diseases might be transmitted to cattle in temperate zones by some vector insects. Epizootics of ephemeral fever, Akabane disease and Ibaraki disease have been confirmed respectively in Korea too. However, it is paradox that Ibaraki disease has not occurred in Australia yet, while ephemeral fever¹³⁾ and Akabane disease⁶⁾ occurred in cattle there.

In Japan cattle have been vaccinated and tended to escape from the disease for long time since last epizootics in 1960. However, this disease recurred sporadically in Kyushu district⁴⁾ in October, 1982 and the disease was also occurred in Korea at the same time.

Summary

Epizootics and sporadic outbreaks of the cattle disease characterized by fever, stomatitis and dysphagia were observed in Korea in September through November, 1982. The number of cattle showed typical symptoms of the disease was estimated to 73 and these animals were concentrated in Gyongido province, the central district of Korea. In other districts around Gyongido province the disease tended to be sporadic occurrence.

The main lesions of the disease were defined as edema, hemorrhage, degeneration and necrosis of the oral mucosa and musculatures of the esophagus and laryngopharyngeal area, and abomasum. Of these lesions hyaline degeneration and hemorrhage of the striated muscle of the esophagus and laryngopharyngeal area were the most striking changes of the disease and rated to be the lesion of diagnostic significance. The serum samples of the cattle with typical symptoms showed significant positive titer of the antibodies against Ibaraki virus. On these clinical, epidemiological, pathological and serological findings of the disease it was diagnosed as Ibaraki disease presenting the only report on the epizootics in the countries other than Japan.

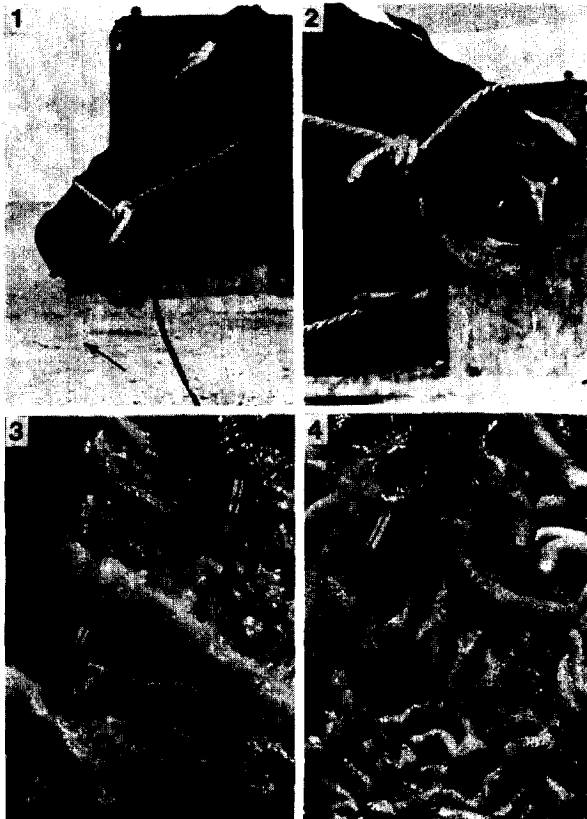
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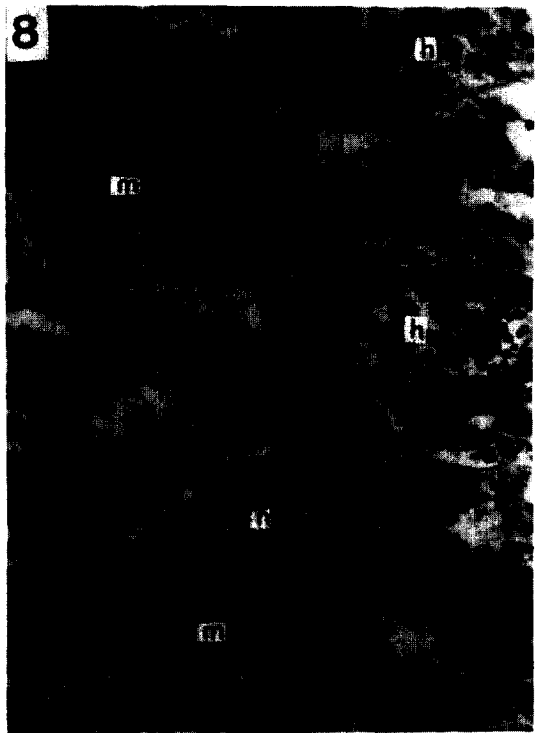
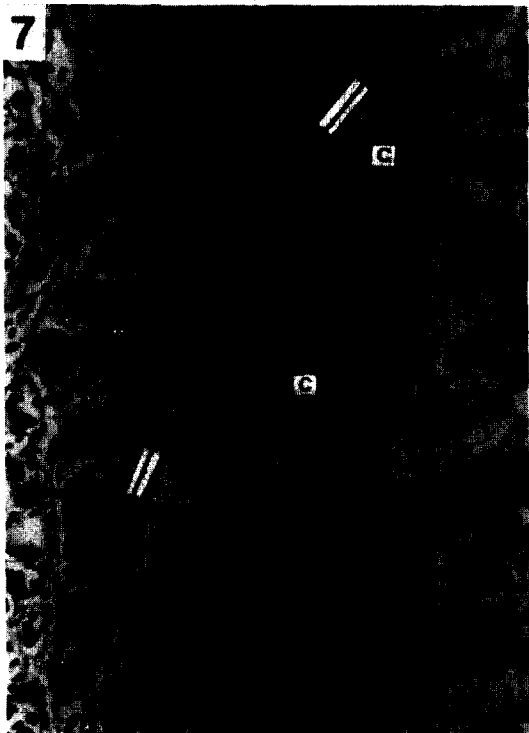
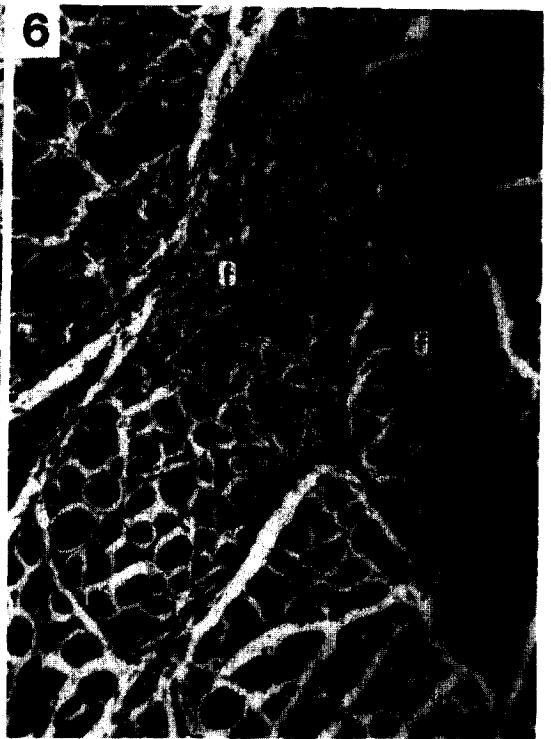
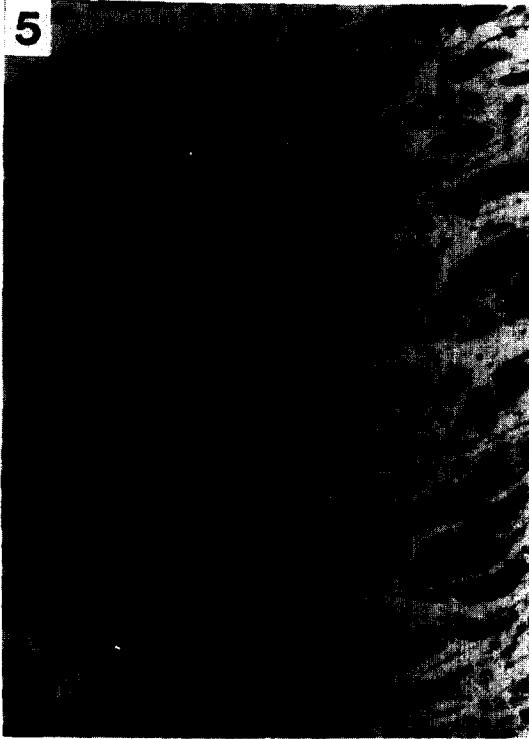
Clinical and gross pathological features of the affected cattle

- Fig 1.** Dysphagic sign of the affected animal showing the swallowed water flowed out of the nose and mouth(arrow).
- Fig 2.** Distinct foamy salivation of the affected cattle.
- Fig 3.** The abomasal lesion of the affected cattle showing dissemination of minute necrotic foci with central ulceration(arrow) on the congested and thickend mucosa.
- Fig 4.** The abomasal lesion of the affected animal showing a large ulcerative focus(arrow) on the thick and rugose mucosa.

Microscopic lesions of the affected animals

- Fig 5.** In early lesion of the esophageal musculature, multiple muscle fibers are swollen, distorted, variable in size and hyalinized. Hematoxylin and eosin (H.E.) stain. $\times 25$.
- Fig 6.** Advanced lesion of affected muscle in the esophagus showing extensive fibrosis around involved area of muscle fibers(f). H.E. stain. $\times 25$.
- Fig 7.** In advanced degeneration of muscle in the esophagus, muscle fibers are found to be dissociated each other, uneven in size, cavitated by sarcolysis(arrow), and stippled with calcific deposition (c). H.E. stain. $\times 66$.
- Fig 8.** Skeletal muscle degeneration in the esophagus showing hyalinized muscle fibers(m), hyperemic capillaries, hemorrhage(h) and infiltration of neutrophils(n) in the empty sarcolemma spaces. H.E. stain. $\times 132$.





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韓國에서의 이바라기 病(Ibaraki disease)의 발생

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抄 錄

1982년 9월부터 11월까지 사이에 京畿道 일원의 소에서 發熱, 口內炎, 嚥下障礙를 나타내는 疾病이 流行性으로 발생하였다. 이와같은 疾病은 같은시기에 忠淸南道, 江源道, 全羅南道 및 慶尙南道の 일부지역에서도 산발적으로 발생하였고, 특징적인 臨床所見으로서 확인된 發生頭數는 73두에 달하였다. 이 疾病에서 관찰된 주요 病變은 口腔 粘膜炎, 咽喉頭, 食道 및 四胃의 水腫, 出血, 變性 및 壞死이었으며 이들 病變중에서도 食道와 咽喉頭肌肉의 碯子樣變性和 出血은 診斷的인 所見으로 간주되었다. 특징적인 臨床所見을 보인 소에서 채취한 血清에서 Ibaraki바이러스에 대한 中和抗體가 증명되었다. 이상과 같은 臨床, 疫學的, 病理學的 및 血清學的 所見에 의하여 이 疾病은 Ibaraki 病이라고 診斷되었으며 日本 이외지역의 발생보고는 처음인 것이다.