Parasternal Congenital Diaphragmatic Hernia in a Calf
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Congenital diaphragmatic hernia does not seem to be rare in cattle in spite of few cases so far reported in this species. Little discussion has also been made concerning the embryological mechanism of this type of anomaly. Troutt et al. [4] pointed out that it is frequently difficult to make a clinical diagnosis of congenital hernia. In a calf to be reported in the present paper, a hernial foramen was found to be located in the pars sternalis of the muscular portion of the diaphragm. Therefore, the present study was made on the relationship between the autopsy findings and the clinical symptoms and on the embryological mechanism of formation of the hernial foramen in this calf.

The calf studied here was a Holstein female born by normal parturition in Hokkaido, Japan. It passed almost the normal period of intrauterine life. After birth, it was already depressed remarkably. The heart sounds could be heard more distinctly on the right than on the left thoracic wall. The heart rate was more than 120/min. These findings suggested the presence of a cardiac deformity, and hence, this calf was offered to the authors' university at its age of 4 days after birth. The mother cow gave birth to a normal calf by the first pregnancy, but gave birth to the present abnormal calf by the second pregnancy throughout which she had never received any drug-treatments.

Clinical findings: In its external appearance, the calf was characterized by its posture with the shoulders squared to the most possible extent and with the interval between the both anterior limbs widened a little (Fig. 1). The visible mucous membranes in the oral cavity and vagina were anemic. The calf exhibited abdominal respiration and dyspnea. The heart sounds were heard more clearly in the intercostal space between the fourth and fifth ribs on the right thoracic wall. The heart rate showed a constant increase from the day of admission to the time of sacrifice, ranging from 136 to 174/min. There was a continuous increase in respiration rate, which ranged from 54 to 84/min. Hematocrit was within a range of 22 to 27%, tending rather to decrease. An electrocardiogram recorded by A-B lead showed no marked changes in wave pattern. The circulatory condition of the heart together with the adjacent aorta and pulmonary artery was observed by tomographic echocardiography. As a result, it appeared to be normal without any defects of interventricular and interatrial septa and without the patent ductus arteriosus. A white cloudy region, however, was found in the left part of the heart, suggesting the presence of some abnormality in the left thoracic cavity. Furthermore, chest roentgenography revealed the invasion of an organ with a jejunoileal appearance into the thoracic cavity. In addition, diaphragmatic hernia was suspected, since a peristaltic sound was heard on the left thoracic wall. Later, severe cyanosis appeared in the tongue. Then, the calf

Fig. 1. Frontal view of the calf while in life. Note its characteristic posture.
showed a poor prognosis, and hence, it was sacrificed by bleeding 9 days after birth and subjected to autopsy. At that time, the calf weighed 47 kg.

*Autopsy findings:* The thoracic cavity was invaded by the omentum major, the whole body of the abomasum filled with gas, the cranial half of the duodenum, a part of the omasum, and a part of the jejunumileum (Fig. 2). An area corresponding to the pars sternalis of the muscular portion of the diaphragm was perforated with an oval hernial foramen about 8.0 cm in longer diameter and about 4.5 cm in shorter diameter (Fig. 3). In the mediastinum, there was a defective portion of elliptic shape about 6.5 cm in longer diameter and about 3.5 cm in shorter diameter, which was situated near the angle formed on the mediastinum by the attachment of the diaphragm. In the recessus mediastini, the plica venae cavae fused with the mediastinum at a height about 4.5 cm on the dorsal side of the sternum. There was another defective portion about 3.0 cm in width on the ventral side of the mediastinum. Through this portion, the left and right thoracic cavities communicated with each other. The hernial foramen of the diaphragm had a smooth edge with no adhesion to the surrounding tissues, causing hemorrhage neither in the thoracic cavity nor in the abdominal cavity. Judging from these conditions of the hernial foramen, a diagnosis of congenital diaphragmatic hernia was made in this case. Joest [2] classified diaphragmatic hernia morphologically. According to Joest, it is assumed that the present case belongs to the type of hernia diaphragmatica spuria pleuralis. According to Langman [3], in the human, congenital diaphragmatic hernia almost always originates from an insufficient fusion of the pleuropitoneal fold, the defective part is often found on the left side of the diaphragm, and parasternal hernia and esophageal hernia are infrequently induced from other causes.

From their review of literature, Haba et al. [1] classified three etiological factors of parasternal hernia as follows: (1) Insufficient invasion of muscle fibers into the pars sternalis of the muscular portion of the diaphragm. As the pars sternalis remains to be thin, hernia is produced therein. (2) Delay in fusion between the xiphoi process and the costal cartilage. Because of this delay, the pars sternalis is disturbed to adhere to the diaphragm. Since the pars sternalis remains to be thin, hernia is formed therein. (3) Inflicted abdominal pressure. In the case of parasternal hernia, the superficial cranial epigastric artery and lymphatic vessel pass through the hernial foramen. Moreover, the central part is weaker than any other part of the tendinous center of the diaphragm. Abdominal pressure is inflicted on such an anatomically weak part to produce hernia.

Of these three factors, the item (1) seems to be the most applicable to the present case. Congenital diaphragmatic hernia does not seem to be one of the rare congenital abnormalities. Since it is difficult to make a diagnosis of this hernia in domestic animals, it is considered that not a few animals suffering from this hernia may have died or been condemned without any
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definite diagnosis. The location of the hernial foramen and the degree of invasion of organs contained in the hernia may not always be determined in such affected animals, but would compose important clews for diagnosis on the basis of the findings in the present calf in which the hernial foramen and the thoracic invasion of abdominal organs were clearly detected by a detailed auscultation of the chest and roentgenography.

Several attempts have been made to correct congenital diaphragmatic hernia surgically. Troutt et al. [4] reported a successful case of such correction. Therefore, the results of the present investigation are expected to contribute to the clinical studies on this type of hernia.

REFERENCES


要約

傍胸骨横隔膜ヘルニアの子ウシの1例（短報）：阿部光雄・平賀武夫・岩佐憲二・竹花一成（酪農学園大学家畜解剖学教室）——1例のホルスタイン種雌子ウシで、傍胸骨横隔膜ヘルニアを観察し、その臨床症状と剖検所見を記載した。この子ウシは外観的には、「いかに初」の姿勢が特徴で、心悸亢進、呼吸速迫、粘膜の貧血などの症状から、当初、心奇形が疑われた。しかし、聴診およびX線撮影により、横隔膜ヘルニアと診断された。剖検により、胸腔内に、第四胃および第三胃、十二指腸、空腸の一部が存在していた。横隔膜筋部の胸骨部に、長径8.0cm、短径4.5cmの卵円形のヘルニア孔が認められた。