Radiographic Investigation of Ulcerative Lesions in the Carpal Joint in Japanese Black Calves

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Almost all slaughtered Japanese Black cattle are suffering from erosive and/or ulcerative lesions in the articular cartilages distal to the carpal and tarsal joints, as we previously reported [2]. Histopathologically, this lesion was characterized by non-inflammatory destruction or degeneration and remodeling similar to the early stage of osteoarthritis [1]. However, this lesion has not been fully understood because the pathophysiology, the cause or the developing factor of the lesion is still unclear. This is partially caused by the difficulty in obtaining the joint specimens of the young cattle or the calf in the slaughter house.

Recently we have demonstrated that this ulcerative lesion in the carpal joint could be radiographically evaluated by using a specific combination of the intensifying screen and the film for mammography even in the young cattle [3]. The purpose of this study is to investigate radiographically the incidence of the lesion in the carpal joint in the different stages of growth, and the relationships between the incidence or the severity of the lesion and the feeding and management system, age and body weight in Japanese Black calves.

Radiographic investigation was conducted on carpal joints of 107 male Japanese Black calves raised in different feeding and management systems (groups A and B) in Yamanashi Prefecture. Seventy-six calves in group A with the age of 1.7 to 12 months old and the estimated body weight of 45 to 271 kg were raised in the wide pasture and given suckling milk (only in 5 months old) or roughage as a main ration. Thirty one calves in group B with the age of 7 to 12 months old and the estimated body weight of 167 to 372 kg were raised in the narrow and crowded pen with limited exercises allowed and most of them had already undergone fattening.

A condenser type X-ray unit (100 kV, 1 μF, Hitachi Medical Corporation) and a combination of single side intensifying screen (MA-II, Kyokko) and a single side emulsion film (Lo-Dose, Dupon) were used for radiographic investigation [3]. Focus-film distance was 100 cm and ranges of the exposure conditions used were from 70 kV, 5 mAs to 80 kV, 35 mAs. All the animals were held in standing position and anterior-posterior radiographs of their carpometacarpal joints were taken.

The lesions were radiographically classified into 5 grades using the following criteria [3]: grade 0: apparently normal, grade 1: slight changes in trabecular patterns in the subchondral bone, grade 2: slight changes in trabecular patterns with the slight irregular joint surface, grade 3: moderate changes in trabecular patterns and the irregular joint surface, grade 4: severe changes in trabecular patterns with irregular or disappeared joint surface (Fig. 1).

Figure 2 shows the radiographic grades of the carpal joint at each month of age in calves in groups A and B.

![Fig. 1. Radiographs of the carpal joint with the lesion in each grade (arrowheads). 0: grade 0—apparently normal, 1: grade 1—slight changes in trabecular patterns in the subchondral bone, 2: grade 2—slight changes in trabecular patterns with the slight irregular joint surface, 3: grade 3—moderate changes in trabecular patterns and the irregular joint surface, 4: grade 4—severe changes in trabecular patterns with irregular or disappeared joint surface.](image-url)
Eighty-four percent of all calves in both groups (1.7 to 12 months old) already had various degrees of lesions, among which the youngest calf was as young as 1.7 months old. The radiographic grades in group B appeared to be higher than those in group A. In calves in group B, all of which were older than 7 months old (9.5±1.8 months old and 249±59 kg of body weight), 78% of them had the severe lesions (grade 3 or 4), while only 35% of the calves older than 7 months old (9.8±1.5 months old and 184±30 kg of body weight) in group A had the severe lesions. Although the very young calves in group A showed less incidence and severity of the lesion, there were no significant correlations between the age and the severity of the lesion in calves older than 5 months old in group A (n=63) and
in all calves in group B (n=31) by Spearman’s correlation coefficient by ranks when the values of P<0.01 were considered significant.

Figure 3 shows the relationships between radiographic grades of lesions and body weight in calves in groups A and B. There were significant correlations between radiographic grades and body weight by Spearman’s correlation coefficient by ranks in both groups (P<0.01). Radiographic lesions tended to be severer in heavier calves. The body weight of most calves with grades 0 and 1 was less than 200 kg, while that of most calves with grade 4 was more than 200 kg.

Those results may be enough to suggest that ulcerative lesion in the carpal joint occur at quite early age in Japanese Black calves regardless to the feeding and management system, since almost all the calves older than 5 months of age in both groups had already had the lesion.

It may also be suggested that the severity of the lesion closely relates to body weight rather than age. As the calves in group B were already under fattening conditions when investigated (7 to 12 months old) in this study, their mean body weight of 249 kg was significantly larger (P<0.01, two sample t test with Welch’s correction) than that of 184 kg in calves of almost the same age in group A.

The standard growth curve in the Japanese Black calf shows that the muscle or the fat tissue grows rapidly after the vigorous growth of the bone [4]. An imbalanced large mechanical stress on the developing bone caused by rapid weight gain by earlier fattening could be born in calves in group B, and this might be one of the major reasons why the calves in group B showed the severer radiographic changes than in calves in group A.

In order to clarify the relationship between the severity of the carpal lesion and the body weight, a further investigation was conducted using 11 calves aging 3 months old in group A. These calves were provided for the serial investigations on the progression of radiographic findings in the carpal joint and monthly gains of body weight and cannon circumference until 11 months of their age.

Figure 4 shows the progression of radiographic grades, and Fig. 5 shows monthly gains of body weight and cannon circumference of 11 calves. Five of 11 calves had certain degree of radiographic lesions even at 3 months of age; grade 1 in 2 calves and grade 2 in other 3 calves. At 6 months of age, 9 of 11 calves had the radiographic lesions in the carpal joint and their grades were progressed as comparing with those at 3 months of age; from grade 2 to grade 3 in one calf, from grade 0 or 1 to grade 2 in 3 calves, and from grade 0 to grade 1 in 2 calves. During the period from 6 to 9 months of age, little changes were observed in radiographic grades. At 11 months of age, all calves had the radiographic lesions with the progression of the grades: from grade 0, 1 or 2 to grade 3 in 4 calves, and grade 1 to grade 2 in 2 calves. Mean monthly gain of body weight during 6 to 9 months of age was apparently lower than that during 3 to 6 months and 9 to 11 months of age, while monthly gain of cannon circumference at this period was higher than other periods.

Those results may support the close relationship between weight gain and the development of the lesion. Little changes in radiographic grades were observed during the period from 6 to 9 months of age. In this period, the bone grows most vigorously and the monthly gain of cannon circumference which can be used as the indicator of growth of bone markedly increased. On the contrary, the monthly gain of body weight decreased temporary, and thus the mechanical stress on the articular surface may be less in this period than in other periods of growth. This reduced mechanical stress might be the cause of little changes in radiographic grades in this period.

In conclusion, it is suspected that the ulcerative lesion in the carpal joint may occur at quite early age in any Japanese Black calf, and the imbalanced mechanical stress may accelerate the development of this lesion.
REFERENCES


