

Insufficient Colostrum Ingestion is a Risk Factor for Polyarthritis and/or Phlegmon in Hand-Reared Reticulated Giraffes (*Giraffa camelopardalis reticulata*): 7 Cases (2003–2012)

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ABSTRACT. Seven reticulated giraffes were hand-reared at Nogeyama Zoological Gardens, because the dam had agalactia. Six of the 7 calves exhibited polyarthritis and/or phlegmon in the lower legs. However, the cause of the disorder was unclear. The present study reviewed the clinical records of the 7 giraffes, including the type and amount of colostrum ingested during the first 72 hr. The disorder involved the fetlocks and carpal and tarsal joints in 6 of the 7 calves within an average of 8 days of birth. The average amount of fed bovine or powdered colostrum was 0–2.4 l in the first 24 hr and 2.0–6.2 l during the first 72 hr. Insufficient colostrum quantity might be a factor in polyarthritis and/or phlegmon.

KEY WORDS: colostrum, hand-reared, phlegmon, polyarthritis, reticulated giraffe

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A reticulated giraffe (*Giraffa camelopardalis reticulata*) pair at Nogeyama Zoological Gardens produced 7 calves between 2003 and 2012. The dam failed to produce milk, and all the calves were hand-reared. Six of the 7 calves exhibited polyarthritis and/or phlegmon in the lower legs at an early stage after birth. However, the cause of the disorder was unclear. Although 2 cases of polyarthritis in the giraffe have been reported [4, 6], to the best of our knowledge, there is no report on multiple cases and the possible cause in the early stages after birth. In this study, we reviewed all clinical records and the amount of fed colostrum, and found that insufficient colostrum might be a risk factor for polyarthritis and/or phlegmon.

All 7 calves that were produced by the same giraffe pair at Nogeyama Zoological Gardens between 2003 and 2012 were included in the present study.

The clinical records of the 7 calves were reviewed. We recorded the date of birth, age when symptoms of polyarthritis and/or phlegmon first appeared, location (s) of the lesion (s), duration of symptoms, outcome and treatment methods. In addition, radiographic examination was performed in 2 calves, and blood testing was conducted in 1 calf. Moreover, average temperature of the month when each calf was born was obtained from the web site of the Japan Meteorologi-

cal Agency (<http://www.data.jma.go.jp/obd/stats/etrn/index.php>).

Regarding colostrum, we reviewed the type, feeding method, and amount administered during the first 72 hr. The colostrum was either bovine colostrum or a powdered colostrum (Saisyo no milk; JA Zen-Noh, Tokyo, Japan); a milk replacer (Hotto milk; Nippon Formula Feed Manufacturing Co., Ltd., Yokohama, Japan) was used after colostrum feeding. The bovine colostrum was obtained from a neighboring dairy farmer, and the number of days postpartum at the time when the colostrum would have been obtained was unknown, thereby resulting in variable and unknown immunoglobulin concentrations. The powdered colostrum and milk replacer were diluted according to the manufacturers' instructions.

Table 1 shows the date of birth, age when the symptoms first appeared, duration of symptoms, outcome and average temperature of the month of birth. The clinical outline of each calf follows.

Calf no. 1 suckled the dam continually and was considered to have ingested sufficient colostrum and milk. However, the calf was found in a moribund state at 4 days of age. At this point, it was recognized that the dam was displaying agalactia or producing only a limited quantity of milk. The calf was first treated with intensive care and then given bovine colostrum manually from 8 days of age. The calf survived, but at 11 days, the fetlock of the left hind limb displayed swelling. Indomethacin (Inteban ointment 1%; Dainippon Sumitomo Pharma Co., Ltd., Osaka, Japan) was applied to the joint. The fetlock of the right forelimb was swollen, and both forelimbs were hot, at 25 days. At 31 days, the carpal joints of the forelimbs and the tarsal joints of the hind limbs displayed swelling. The subcutaneous tissue of the right metacarpal

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Table 1. Individual data of the date of birth, age when symptoms first appeared, duration of symptoms, outcome and average temperature of the month of birth

Calf no.	Date of birth	Age of onset (days)	Duration of symptoms	Outcome	A.T.M. (°C)
1	14 Jan. 2003	11	1 year	Euthanizing	5.2
2	18 Jul. 2004				27.5
3	17 Dec. 2005	4	6 months	Complete resolution	15.8
4	8 Jun. 2007	6	3 months	Complete resolution	22.4
5	7 Jan. 2009	6	10 days	Death (Pneumonia)	6.7
6	24 May 2010	6	15 days	Complete resolution	18.4
7	7 Feb. 2012	15	15 days	Complete resolution	5.4

A.T.M. (°C): Average temperature of the month of birth.

Table 2. Amount (ml) and type of colostrum administered to the 7 calves until 72 hr after birth

Hours after birth (less than)	Calf No.						
	1	2	3	4	5	6	7
6			0	2000	0	0	0
12		Remained with the dam	0	0	2000	0	800
18			400	0	0	2000	0
24		0	2000	0	0	0	1270
30		0	0	0	0	0	938
36	Remained with the dam	0	0	0	0	0	0
42		0	<1200>	0	0	0	0
48		1500	<1000>	0	0	0	924
54		0	0	0	0	0	737 <734>
60		0	0	0	0	400	0
66		120 <120>	<1500>	0	0	2500	0
72		0	<1700>	0	0	1250	<1840>
Type of colostrum		Bovine	Bovine	Powdered	Powdered	Powdered	Powdered

<>: Amount of milk replacer.

and metatarsal bones was swollen at 46 days of age. Amoxicillin (Anxin; Meiji Seika Pharma Co., Ltd., Tokyo, Japan; 10 g, PO, q 24 hr for 7 days) and ciprofloxacin hydrochloride (Ciproxan; Bayer Yakuhin Ltd., Osaka, Japan; 300 mg, PO, q 24 hr for 33 days) were administered from 284 days of age, because septic arthritis was indicated on radiographic examination. However, the joint disorder did not improve; further, the extremities were abnormally crooked, and each limb was a different length. The calf displayed astasia at 323 days of age and was euthanized.

Calf no. 2 did not display any arthritis signs.

Calf no. 3 exhibited swelling of the fetlock of the right hind limb at 4 days of age. The calf was given amoxicillin (3.5 g, PO, q 24 hr for 4 days), and the symptom resolved. The calf frequently lifted the right hind limb when standing from 16 days of age, and the inner hoof of the right hind limb subsequently grew excessively, which necessitated trimming on 3 occasions in the first year. The fetlock of the right hind limb was swollen again at 57 days, and the right carpal joint displayed swelling at 133 days. Although oral amoxicillin was administered intermittently when joint swelling deteriorated, the calf developed diarrhea readily and the drug could not be administered for more than 10 days. After 6 months, the joint disorder had resolved. However, the hoof remained long, possibly because conformation changes resulted in

ongoing excessive growth.

Calf no. 4 displayed swelling of the left carpal joint at 6 days of age. Anti-inflammatory ointment (Kanmerupasuta; Nippon Zenyaku Kogyo Co., Ltd., Fukushima, Japan) including dl-menthol, dl-camphor and methyl salicylate was applied for 30 days. The joint disorder was recovered after 3 months.

Calf no. 5 displayed swelling of the left and right carpal joints at 6 days of age. Although anti-inflammatory ointment was applied, the calf died at 10 days of age because of pneumonia.

Calf no. 6 showed mild swelling of the fetlocks of both forelimbs at 6 days of age. However, the swelling resolved without any treatment.

Calf no. 7 displayed swelling of the fetlocks of both hind limbs, subcutaneous tissue of the left metatarsal bone and left tarsal joint at 15 days of age. Radiological examination revealed that the soft tissue around the fetlock, metatarsal bone and tarsal joint was slightly swollen. In addition, hematological tests at 21 days showed that the white blood cell count was 24,517/ml, indicating that the swelling might be septic polyarthritis or phlegmon. The calf was administered sodium cefamezin (Rasenazolin; Nichi-Iko Pharmaceutical Co., Ltd., Toyama, Japan; 500 mg, IM, q 24 hr for 6 days). At 29 days of age, the swelling was not detectable, and the

white blood cell count had decreased to 13,280/ml.

The details of colostrum administered to the 7 calves until 72 hr after birth are shown in Table 2. The outline of each calf until hand-rearing follows.

Calf no. 1 remained with the dam until it was found moribund at 4 days of age. Consequently, the calf did not receive any colostrum until hand-rearing started via a stomach tube at 8 days of age.

Calf no. 2 was kept with the dam for the first 18 hr. Although the calf suckled the dam, the suckling duration was very short and the dam did not accept the calf suckling. Therefore, we decided that all calves after calf no. 2 would be hand-reared soon after birth. The calf refused to drink bovine colostrum from a feeding bottle. Therefore, colostrum was administered via a stomach tube at 48 hr after birth. The calf was given the colostrum mixed with milk replacer with a feeding bottle at 66 hr after birth and the milk replacer only from 72 hr.

Calf no. 3 was born at night and seemed not to suckle the dam by the morning. It took a long time to separate the dam from the calf, so the calf was administered bovine colostrum via a stomach tube at 18 and 24 hr after birth. The calf drank the milk replacer from a feeding bottle from 42 hr.

Calf no. 4 was born during the day and nos. 5 and 6 at night. They had not suckled the dam at 6, 12 and 18 hr, respectively. The calves were separated from the dam at varying times after birth depending on the difficulty of separation. Immediately after the separation, they were administered powdered colostrum via a stomach tube. Thereafter, the calves refused to drink anything from a feeding bottle, but calf nos. 4 and 5 drank milk replacer from a feeding bottle from 96 and 84 hr after birth, respectively, and calf no. 6 drank powdered colostrum from the bottle from 60 hr after birth.

Calf no. 7 was separated from the dam soon after birth and drank powdered colostrum from a feeding bottle. The calf was given the powdered colostrum mixed with milk replacer at 54 hr and the milk replacer only from 72 hr after birth.

Calf nos. 1, 3, 4, 5, 6 and 7 contracted polyarthritis and/or phlegmon at an early stage of life. All 6 cases displayed similar ages at onset and symptoms of swollen joints and phlegmon, but the degree and duration of the symptoms varied.

The cause of polyarthritis and/or phlegmon was considered insufficient colostrum intake, which might have induced immune incompetence. In the present study, the giraffe calves were given bovine or powdered colostrum. However, the immunoglobulin concentration differed between these colostrum types. In the present study, the IgG concentration of the bovine colostrum was not measured. However, a previous study reported that the IgG concentration is 40 mg/ml in high-quality fresh bovine colostrum in Japan, although this is highly variable [7]. On the other hand, the concentration of the IgG in the powdered colostrum is 100 mg/ml according to the product description. Generally, a giraffe calf weighs approximately 60 kg at birth [2]. The required volume of bovine colostrum for a giraffe calf is 6–10% of body weight per day until 3 days of age [3], which equates to 3,600–6,000 ml/day. Although the required volume of the powdered co-

lostrum in a giraffe calf was not stipulated, the volume of fed colostrum was calculated using the giraffe's body weight according to the instructions of the powdered colostrum. This was calculated as 2,000 ml on day 1, 2,600 ml on day 2 and 1,300 ml combined with 1,300 ml of the milk replacer on day 3. Therefore, in the present study, all the calves have received an insufficient amount of colostrum. Moreover, the calves, except for calf nos. 1 and 7, refused to drink the milk from the feeding bottle at first. Calves should receive adequate colostrum within 24 hr of birth. We attempted first to accustom the calves to the bottle, and the consequent delay in and inadequate colostrum ingestion might have affected the immunocompetence of the calves. Sufficient colostrum should have been administered to the calves via the stomach tube as soon as possible after birth.

Insufficient colostrum ingestion might have adversely affected immunocompetence and predisposed to septic arthritis. The bovine calf is known to exhibit neonatal lameness and septicemia due to insufficient colostrum intake [8]. Moreover, previous reports noted that the giraffe calf did not receive the dam's colostrum, which might have caused the disease [4, 6]. In the present study, in calf no. 7, the hematological and radiographic findings, and the response to antibiotic treatment, indicated that the cause of polyarthritis and/or phlegmon might have been infection. The symptoms and age of onset of all the calves were similar to those of calf no. 7. Therefore, they might have suffered the same disorder associated with immunocompetence and septic arthritis.

Calf nos. 1, 3, 5 and 7 were born in the cold season and displayed more severe symptoms or died within the first year compared with calf nos. 2, 4 and 6, which were born in the warm season. The giraffe calves born in the cold season might have suffered from cold stress, which exacerbated the symptoms of polyarthritis and/or phlegmon.

In the present study, it was unclear whether the dam was displaying agalactia or producing a small amount of colostrum. However, even if the dam produced only a small quantity of milk, the calf could acquire immune activity, albeit weak. Therefore, calf nos. 1 and 2 might have been able to acquire weak immune activity. The reason why the symptoms differed between calf nos. 1 and 2 is considered the difference in temperature of the birth month. Weak immune activity in addition to cold stress might have induced more severe symptoms in calf no. 1, born in the cold season, compared with calf no. 2, born in the hot season. Therefore, in the present study, the calf born in the cold season should have been administered colostrum by hand in addition to the dam's natural nursing.

Septic arthritis and phlegmon are known to be caused by trauma or systemic infection [5]. No trauma was recorded in any of the 7 calves. Therefore, systemic infection might have been the key factor in the septic polyarthritis and/or phlegmon in the present study. Common sources of infection are enteritis, pneumonia and funisitis in the bovine calf [1, 5]; enteritis and pneumonia were not recorded in the giraffe calves before the onset of arthritis; therefore, funisitis was a possible infectious source. The calves with the lack of immunocompetence might have been prone to umbilical cord

infection, from which the infection spread systemically. This systemic infection might have induced the septic polyarthritis and/or phlegmon.

As far as we know, this is the first report to describe multiple cases of septic polyarthritis and/or phlegmon in giraffe calves at an early age in which insufficient colostrum intake might have been a factor, and cold stress might have contributed to the severity of the symptoms.

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