

A case of mastitis in an allomother mongrel bitch nursing a jaguar cub

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Received 19.01.2022

Accepted 21.02.2022

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Summary

Allonursing is typical in mammals, especially in the polytocous taxa with large litters. One of the immediate benefits of allonursing is milk evacuation of distended mammary glands, especially in females who lost their offspring, predisposing them to mastitis. Mastitis represents the inflammation of the mammary gland and in carnivores it can affect a section of the gland or the entire mammary tissue (13). Therefore, it is considered an emergency (2, 15) since if left untreated mastitis can suffer local and systemic complications like mammary gangrene, septicemia, or neonatal mortality. This case report presents a mastitis episode in an allomothering mongrel bitch after starting to allonurse a one-day-old jaguar cub and her single puppy. Laboratory assays showed the presence of mild leukocytosis, folded milk C-reactive protein (CRP; 5.1 µg/mL) levels, an alkaline milk pH reaction (pH > 7), increased cell counts, phagocytosis, and presence of *Staphylococcus aureus* and *Enterococcus faecalis* in the cultured milk samples.

Keywords: allonursing, bitch, mastitis, milk CRP, jaguar cub

Allomothering is typical in many mammalian species (3, 31). It is common, especially in matriarchal societies (16, 24), where the litter is assisted and protected by siblings and family members. It is more often encountered in dogs, cats, and pigs (polytocous taxa), than in primates, ruminants, or bats (monotocous taxa) (3). Allonursing can also be an artifact of disturbances, crowding, or captivity, as it is more commonly encountered in captive individuals, including in Zoo animals (3).

In monotocous taxa, especially in animals that live in large groups, allonursing is typically associated with milk theft (parasitism). The lower level of allonursing may result from a decreased tolerance towards non-offspring by the lactating females. This form of parasitism is not readily signaled in the polytocous

taxa, where communal nursing may be restricted to polytocous animals that live in smaller groups but with large litters (3).

Many hypotheses are concerned with explaining this behavior in nursing females. As litter size increases, it may be more difficult for females to recognize their offspring or restrict nursing access only to them. Polytocous females may be more tolerant because allonursing costs decrease with increasing litter size. However, the incidence of non-offspring nursing in polytocous species declines as group size increases (3). To improve their maternal skill, inexperienced females who lost their litter or have pseudopregnancy nurse alien offspring. Allomothering is also highly beneficial for these females since it helps evacuate leftover milk, reduce intra-mammary pressure and

pain, and avoid mammary gland pathologies such as mastitis (3, 24, 31, 45). However, in some cases, the habits and behavior of the pups for milk sucking can be physically too aggressive and can cause mammary gland injuries.

Mastitis is one of the most common reproductive disorders in bitches. It has a wide variety of forms, from non-septic galactostasis to septic, acute, gangrenous, or chronic inflammation, causing from subclinical to severe systemic illness (39). The diagnosis of mastitis is based on medical history, clinical examination, and additional laboratory assays like milk pH, cytology, and serum/milk CRP evaluation (38).

Even though one of the main benefits of allonursing is to avoid increased mammary gland pressure by leftover milk or local inflammation and infection, this report describes a clinical case of bilateral abdominal mastitis in an allomother mongrel bitch, that allonursed a jaguar cub, pointing out that mammary discomfort or mastitis can occur in allomothers as well.

Case report

Starting from the third day postpartum, a 4-year-old healthy, 20 kg, dewormed and vaccinated, multiparous mongrel bitch allonursed a one-day-old captive-born male jaguar cub in a Zoo from Southern Transylvania, Romania, along with her single born pup. The allosuckler was fed until three weeks old by the lactating bitch 4 to 5 times a day and hand-reared with an additional 10-20 mL/intake of a commercial feline formula (Babycat milk, Royal Canin, France) to complete the cub's nutrient demands (22, 34).

Ten days after allonursing, scratch marks along with a slightly nodular surface were observed on both the left (M4.1) and right (M4.2) caudal abdominal mammary glands of the bitch. None of the mammary glands or milk secretions presented other overt clinical signs of infection. Neither the jaguar cub nor the pup showed any clinical signs of illness. Therefore, it was decided to let both offspring suckle under strict supervision. Nevertheless, blood and milk analyses were performed to assure the health status of the bitch and to prevent or exclude any possible complications (i.e., mastitis, septicemia).

The blood sample was collected from the cephalic vein and allocated in a tube with EDTA (approx. 1 mL, VacutestKimasr.l., Piove di Sacco PD, Italy) for hematology analysis and in a silicone tube with clot activator (approx. 2 mL; VacutestKimasr.l., Piove di Sacco PD, Italy) for biochemistry analysis. In addition, milk samples were aseptically collected from each of the affected mammary glands (approx. 0.5 mL) into sterile vials (Nunc™, Waltham, USA), with sterile gloves, after a thorough cleaning of the mammary glands with 70% alcohol (19).

A complete blood count (CBC) was determined with Abacus Junior Vet analyzer (Diatron Messtechnik, Budapest, Hungary), while differential blood count was counted on blood film stained with Dia-Quick Panoptic dye (Reag-Fix Panoptic, ReagensKft., Budapest, Hungary) (42).

For biochemical assays, the UV-VIS Screen Master Touch Spectrophotometer analyzer (Hospitex Diagnostix,

Fiorentino, Italy) was used. The blood was left to clot at room temperature for 30 min and then centrifuged ($1200 \times g$, 15 min) to obtain serum. The milk samples were centrifuged ($21,000 \times g$, 30 min, 4°C) to remove fat (37). For serum Haptoglobin (Hp), a commercial Enzyme-Linked Immunosorbent Assay kit (ELISA; Tridelta Development Limited, Ireland) was used, according to the manufacturer's instructions and guidelines. Both serum and milk CRP levels were determined using the TR-IFMA method (27).

Milk smears were performed using the "squash" and May-Grünwald Giemsa (MGG) (E. Merck, Darmstadt, Germany) techniques. The milk pH was evaluated with litmus paper (E. Merck, Darmstadt, Germany) (38, 43).

Standard microbiological tests were used to isolate and differentiate bacterial pathogens. Milk samples were plated on 5% sheep blood, Chapman, and MacConkey agars (Oxoid Limited, Hampshire, UK) after a 24-72 h incubation at 37°C (21, 33). According to the manufacturer's instructions and guidelines, bacterial isolates were identified with commercial Vitek2 GP kits (BioMérieux, l'Étoile, France).

Preventive treatment measures were adopted by monitoring pups and the bitch during and after feeding following previously recommended guidelines (4, 11, 15, 29, 39, 44). In brief, the hair around the teats of the mammary glands was shaved, local warm compresses were applied over the affected areas, and the glands were covered to prevent further excoriation by offspring nails during feeding.

Blood tests showed the presence of mild leukocytosis with monocytopenia and eosinophilia without significant alteration in serum biochemistry (Tab. 1 and 2).

Milk analysis revealed an alkaline milk pH (> 7), a folded milk CRP level, and the presence of an increased number of foamy cells, macrophages, cellular debris, and neutrophils

Tab. 1. Haematological values

Analyte	Values	Reference range
RBC ($10^{12}/\text{l}$)	6.00	5.50-8.50
HGB (g/l)	125	120-180
HCT (%)	39.60	37-55
MCV (fL)	75	60-77
MCH (Pg)	23.70	19.50-24.50
MCHC (g/l)	316	310-340
PLT ($10^9/\text{l}$)	273	200-500
WBC ($10^9/\text{l}$)	18 H	6-17
Band N (%)	1	0-3
Segmented N (%)	67	58-85
L (%)	14	8-21
M (%)	1 L	2-10
E (%)	17 H	3-9
B (%)	0	1

Explanations: WBC – white blood cells; RBC – red blood cells; HGB – hemoglobin; HCT – hematocrit; MCV – medium cell volume; MCH – mean corpuscular hemoglobin; MCHC – mean corpuscular hemoglobin concentration; PLT – platelets; N – neutrophils; L – lymphocytes; M – monocytes; E – eosinophils; B – basophils; L – decreased value; H – increased value

Tab. 2. Serum biochemical analysis

Analyte	Serum values	Reference range
Protein (g/dL)	5.9	4.2-5.9
Albumin (g/dL)	2.6	1.8-3.1
Globulins (g/dL)	1.2	0.4-1.0
CRP (µg/mL)	8.5	< 10.0
Hp (mg/mL)	0.9	< 3.0

Explanations: CRP – C-reactive protein; Hp – haptoglobin

Tab. 3. Milk changes from the affected mammary glands

Mammary glands	pH	Cytology	Isolates	CRP µg/mL
M4.1	7	Presence of degenerated neutrophils and foamy cells with phagocytosis	<i>S. aureus</i> and <i>E. faecalis</i>	4.9
M4.2	7			5.1

Explanations: M4.1 – left caudal abdominal mammary gland; M4.2 – right caudal abdominal mammary gland

with engulfed bacteria on the milk smears of both milk samples (Tab. 3).

Moreover, *S. aureus* and *E. faecalis* were isolated from both milk samples. Overall, these data indicate the presence of acute mastitis due to ascending infection in both tested mammary glands.

Results and discussion

Medical history, clinical examinations, and additional laboratory findings confirmed the presence of acute mastitis. Mammary gland inflammation is a common mammary gland pathology in carnivores and is usually caused by ascending or descending glandular infections (8, 10, 39). The ascending path of infection is caused by the presence of skin lesions on the *mammae's* surface, produced by the nurslings, during suckling, with their nails, or after biting the nipples, or by unsanitary dwelling conditions, which will favor the infection through the milk ducts, into the *mammae's* parenchyma (10, 14, 39).

In the present case, the diagnosis of mastitis was confirmed by milk analysis (pH, cytology, CRP, and microbiology) in agreement with previous reports (1, 12, 25, 32, 38, 41, 43). On the other hand, no systemic alterations were observed on physical or laboratory examinations except for a mild leukocytosis due to eosinophilia. Eosinophilia is a common finding in dogs in response to tissue damage (23). Therefore, the mammary cutaneous tegumentary lesions could cause the detected eosinophilia in the current case.

Our findings are consistent with other reported results (37), where folded levels of both milk and serum CRP were detected. However, only the milk CRP level was significantly folded in the current case, suggesting that the inflammatory processes were detected early before any other systemic reactions occurred. Therefore, to diagnose and accurately manage different reproductive disorders, including mastitis, the

determination of the acute-phase protein's response is recommended (5-7, 37).

Usually mastitis in bitches is caused by monoinfections with *Streptococcus canis*, *S. intermedius*, *S. epidermidis*, *S. pseudintermedius*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus mirabilis*, or *Klebsiella pneumoniae* (9, 33, 35, 36, 39, 40). However, coinfections between *S. aureus* and *S. intermedius*, or between other types of bacterial strains, had also been reported (33, 35, 40, 41). In the present case, a bilateral acute mammary infection was identified in the allomother, caused by a coinfection of the caudal abdominal mammary glands with *S. aureus* and *E. faecalis*.

Mammary infections with *S. aureus* or *E. faecalis* are responsible for the onset of acute mastitis in lactating bitches (9, 18, 35, 36) and septicemia and mortality in the suckling puppies (20, 33, 41, 46). Moreover, approximately 65% of the bacterial infections of the puppies are responsible for neonatal deaths (20), thus highlighting the role that bacterial translocation can play in carnivore neonatal mortality and the importance of early detection and treatment of mastitis in female dogs.

Alloparenting, including allonursing, is reported in most wild *Canis* spp. (17). Moreover, it is typical, atavistic behavior in domestic dogs (26, 28) and is much more common in bitches related to each other (30), reported in more than 60% of the litters from home or kennel-raised individuals (28). Moreover, if required, allonursing can be easier implemented, by the breeders, in the first weeks postpartum (30).

In the current case, the paradigm consists in the development of mastitis in the allomother bitch, which might have been caused by the presence of the scratch marks observed on the mammary gland surface, due to the nursing behavior of both sucklings, especially by the alien jaguar cub, that alone or together might have caused the cutaneous damage during feeding. Moreover, the mammary infection might have also been favored by the mismatch between the copious milk production and the low number of litter, causing the buildup of milk in the lactating mammary glands (13, 43).

Overall it can be concluded that allomothering is not a risk-free phenomenon. The presence of mastitis is not neglectable. Nevertheless, in every clinical case of mammary infection, extra care should be provided to both the cubs and allomothers to prevent possible complications, especially when orphaned, endangered, or wild cubs from zoos or rehabilitation centers are implied.

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