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CASE REPORT

Food/farmed animals

Colibacillary arthritis and severe osteomyelitis in lame goat kids due to management procedures

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Abstract

Lameness in the hindquarters was seen in twenty goat kids out of a group of 90 on a dairy goat farm. Initial treatment with antibiotics and NSAID's did not improve the condition. At necropsy in eight kids, a multi-resistant *Escherichia coli* was isolated from affected femurs, strongly indicative of colibaccilary osteomyelitis. In addition, with 573–915 mg/kg dry matter, liver copper concentrations were increased. Predisposing factors for osteomyelitis were poor colostrum quality, stress as a consequence of multiple simultaneous management procedures, preventive use of antibiotics, and elevated liver copper concentrations in the kids. To prevent future outbreaks, it was advised to improve colostrum management, reduce stress by spreading procedures such as vaccinations, disbudding, and dietary changes. Antibiotic treatments should be used only to treat individual kids, and not preventively. Elevated liver copper should be reduced by minimising the copper content in milk replacer.

BACKGROUND

The acute lameness outbreak with underlying osteomyelitis in goat kids was unprecedented. Multiple simultaneous procedures are a severe risk factor for stress and concomitant diseases, specifically in young animals. Prophylactic use of antibiotics could increase the risk of antimicrobial resistance and is, therefore, a public health concern. Supplementation of minerals and vitamins as a preventive measurement should be based on test results.

CASE PRESENTATION

In May 2018, an acute lameness outbreak occurred in approximately 20 out of a group of 90 kids three to five weeks of age on a farm with approximately 800 dairy goats. This lameness, classified with severity three out of five, presented in the hindquarters and was associated with non-weight bearing on mainly the left hindquarter. Initially, affected kids were treated individually, and later whole-group treatments were performed with several antibiotics, multivitamins, and NSAID's. Because of unsatisfactory improvement after treatment, a seven week old clinical representative was submitted for necropsy to the pathology department of Royal GD (GD), the Netherlands. After a farm visit by GD veterinarians specialised in small ruminant health management, seven more clinically affected kids were submitted for post-mortem examination.

Routinely, during the five week kidding period on this farm, the female goat kids were separated from their dams directly after birth, their navels were disinfected with an iodine solution, and they were placed in individual boxes where they received 80 grams of artificial colostrum (Vitalfirst®, Denkavit) dissolved in water, as well as a preventive treatment of tulathromycine (Draxxin®, Zoetis). After this, they were transferred to a rearing facility a few kilometres from the dairy goat barn and approximately twelve hours after birth, they were placed in groups of ten kids on a concrete and rubber flooring with saw dust. They had ad libitum access to an automatic milk feeder with a milk replacer (Caprifit®, Denkavit). Because of pneumonia problems in the previous kidding season, in addition doxycycline (Doxycycline HCL®, Dechra) and a mineral and vitamin supplement (Vitalcure®, Denkavit) were orally administered via the milk as a preventive measure. Disbudding took place around three weeks of age and at the same time they were vaccinated against paratuberculosis (Gudair®, CZ Veterinaria SA) and pasteurellosis (Ovipast®, MSD), and placed in a larger group ($n = 90$) on the same flooring. At the same time, grinded straw and concentrates were added to the diet. The week after regrouping, diarrhoea was seen and treated as coccidiosis (Vexocan®, Elanco). At the age of five weeks, they were again moved and housed on straw. Lame kids were treated orally with amoxicilline (Octacilline®, Dechra), and parenterally with ampicilline (Albipen LA®, MSD), meloxicam (Novem 20®, Boehringer Ingelheim), and glucocorticoids (Dexamedium®, MSD).

Medication, artificial colostrum, milk replacer, and supplements were given according the manufacturers prescription.

Male kids were raised differently; they stayed with their mothers for one day, so that they could drink colostrum, and were thereafter placed directly on straw bedding where they had ad libitum access to an automatic milk feeder with a milk replacer (Caprifit®, Denkavit). No lameness problems were seen in this group. Female kids were not given goat colostrum to prevent possible transmission of caprine arthritis encephalitis virus (CAEV) and caseous lymphadenitis (CLA), although this farm was CAEV and CLA accredited.

INVESTIGATIONS

In total eight kids were submitted for necropsy; one by the farmer, three after the first farm visit and four after the second farm visit (results presented in Table 1).

Routine gross post mortem examination of the initially submitted kid revealed slight fibrinous arthritis of the left knee joint. Upon microscopic examination of haematoxylin and eosin coloured formalin fixated and paraffin embedded (FFPE) tissue of the brain, slight meningitis was seen. The spinal cord did not show any abnormalities. Bacteriological culture of the knee joint and spleen was negative. Macroscopic examination of the three kids selected during the first farm visit revealed serofibrinous arthritis of the right carpal joint and right hock joint in one kid, a purulent arthritis in both knee joints in the second, and slight swelling of the spleen in all three animals. Microscopic examination of the distal right femur revealed purulent osteomyelitis, and minimal osteochondrosis in all animals. Inflammation of the brain or skeletal muscles was not observed. Bacteriological culture demonstrated the presence of *Escherichia coli* in the carpal joint, the knee joints and the spleens, the latter being an indication of septicaemia. In addition, *E. coli* was cultured from the kidney of two animals. A pooled liver tissue sample was tested for metals and trace elements (selenium, arsenic, cadmium, chrome, cobalt, iron, copper, lead, molybdenum, nickel, vanadium, and zinc). Tissue samples were prepared for analysis using microwave-assisted digestion (Agilent Technologies, Santa Clara USA) in nitric acid. Analysis was done using inductively coupled plasma mass spectroscopy (ICP-MS) (Agilent Technologies, Santa Clara USA). In the tested livers, the copper level was increased (573 mg/kg dry matter) (Table 1). The other metals and trace elements were within the normal range.

The four additionally submitted lame kids had ulcerative lesions of the articular cartilage of the trochlear groove of the left femur, microscopically concomitant with chronic necrotizing or necropurulent osteomyelitis (Figure 1), from which no causative agents were cultured. Minimal osteochondrosis was seen in all four animals. One of the animals also had foci of chronic purulent inflammation in three ribs associated with the presence of *E. coli*, and purulent omphalitis. Another animal demonstrated slight overfilling of the right knee joint, of which the culture demonstrated various bacteria with a predominance of *Enterococcus hirae*. All animals had lesions on the left side of the neck or axillary region due to injections, and foamy contents of the rumen associated with degenerative changes of the epithelium at microscopic examination. A foamy content was also seen in the abomasum of one animal. The three remaining kids had undigested roughage in the abomasum. Liver copper content in the pooled samples was 915 mg/kg dry matter (Table 1), the other metals and trace elements were within the normal range. No abnormalities were seen at clinical inspection on disbudding sides, nor was there evidence of rough handling of kids such as catching by their hind limbs.

LEARNING POINTS/TAKE HOME MESSAGES

- Multiple simultaneous management procedures possibly cause severe stress to kids and could result in a decreased immune response.
- Colostrum of good quality given directly after birth is an essential part of rearing young ruminants.
- The prophylactic use of antibiotics is strongly associated with acquired antimicrobial resistance and should therefore no longer be applied.
- Adding extra vitamins and minerals to feed should only take place after laboratory testing has shown that it is necessary.

During the farm visits, management of the rearing period was discussed and it was concluded that there were too many procedures around disbudding (Figure 2), potentially creating severe stress. In summary, supposed lack of transfer of immunity by artificial colostrum, stress of multiple simultaneous management procedures, preventive use of antibiotics and high liver copper values resulted in an environment in which *E.coli* was able to cause septicemia with arthritis and osteomyelitis in many animals.

DIFFERENTIAL DIAGNOSIS

Treatment

The initial antibiotics and NSAID's were prescribed by the local practitioner and therefore no further treatment was initiated. Because *E. coli* was the instigator of septicemia with arthritis and osteomyelitis, the farmer was advised to mend the environment in which *E. coli* could thrive. Therefore management procedures, specifically in young animals, should be spread in order to reduce stress. For this farm regrouping should happen the week before disbudding, and vaccination and feed changes should not coincide (see Figure 3). To reduce the risk of creating multiresistant bacteria, antibiotic treatments should only be used to treat individual kids, and not preventively.

Increased liver copper concentrations generate a potential risk for hepatocellular necrosis[2,3] and therefore addition of minerals and vitamins to milk replacer should stop. In addition, because of inadequate transfer of immunity by artificial colostrum it was advised to give all kids colostrum from their mothers.

Ultimately, a good hygienic standard like changing needles between animals when vaccinating or during treatment, is considered good farm practice which should always be maintained.

OUTCOME AND FOLLOW-UP

No new cases of lameness were seen in the remaining yearlings born in April 2018. In June 2019, the farm was revisited to evaluate the most recent kidding period. No cases of lameness

TABLE 1 Clinical signs, results of necropsy, histology, and bacteriological examination, and liver copper content in seven lame dairy goat kids

Kid no	Clinical signs	Necropsy macroscopic	Necropsy microscopic	Liver (Cu mg/kg dry matter)*	Bacteriological examination	Antimicrobial resistance	Antimicrobial susceptibility
Kid 1	Lameness	Fibrinous arthritis left tibiofemoral joint	Meningitis	Nt	Nt	Nt	Nt
Kid 2	Lameness	Purulent arthritis both tibiofemoral joints	Purulent osteomyelitis of distal part of right femur	573	*E. coli*	amp, flf, sul, oxy, tia, til, stm, tyl[a]	amx, cef, col, eno, flu, gen, kan, spe, tri, tms[a]
Kid 3	Lameness	Serofibrinous arthritis right carpal and tarsal joint	Purulent osteomyelitis of distal part of the right femur	573	*E. coli*	Nt	Nt
Kid 4	Lameness		Purulent osteomyelitis of distal part of right femur	573	*E. coli*	Nt	Nt
Kid 5	Lameness	Ulcerative lesions left femur	Necropurulent osteomyelitis of left femur	915	Nt	Nt	Nt
Kid 6	Lameness	Ulcerative lesions left femur	Necropurulent osteomyelitis of left femur	915	*E. hirae*	cef, cln, kan, cfx, sul, oxy, til (med)[a]	amx, amp, eno, tyl, flf, pen, tms[a]
Kid 7	Lameness	Ulcerative lesions left femur Purulent inflammation rib	Necropurulent osteomyelitis of left femur	915	*E. coli*	amp, flf, sul, oxy, tia, til, stm, tyl[a]	amx, cef, ctx, col, eno, flu, gen, kan, spe, tri, tms[a]
Kid 8	Lameness	Ulcerative lesions left femur	Necropurulent osteomyelitis of the left femur	915	*E. coli*	amp, flf, sul, oxy, tia, til, stm, tyl[a]	amx, cef, ctx, col, eno, flu, gen, kan, spe, tri, tms[a]

Abbreviation: Nt: Not tested.

[a]amp: ampicillin/amoxicillin, amx: amoxicillin clavulanix acid, cef: 3rd and 4th cephalosporin, cfx: oxa-, cloxa-, nafcilline, cefoxitin, cln; clindamycin/lincomycin, col: colistin, eno: enro-, cirpo-, dano-, di- marbofloxacin, ctx: cefotaxim, flf: florfenicol, flu: flemequine, gen: gentamycin, kan: neo-, kana, paromycin, framycetine, oxy: tetra-, oxytetra-, doxycycline, pen: penicillin, spe: spectomycin, stm: streptomycin/dihydrostreptomycin, sul: sulfonamides, tia: tiamulin, til: tilmic/tildipirosine/gami/tulathromycin, tms: trimethoprim sulfonamides, tri: trimethoprim, tyl: tylosin/erythromycin,

*The liver samples of the first three kids are pooled together, as are kid four till kid seven. Higher as.900 mg/kg dm is seen as chronic intoxication, normal values should be below 115 mg/kg dm.[1]

occurred in kids born in 2019. The farmer has adjusted his management in various ways: the procedures were spread out. Pneumonia vaccination was moved to two days after disbudding, feed changes took place five to seven days after disbudding, additional minerals and vitamins supplements were not added to the milk replacer, and for every injection a new needle was used. The preventive use of antibiotics, however, remained the same and paratuberculosis vaccination still coincided with disbudding.

DISCUSSION

Histopathological examination of the first kid did not lead to a diagnosis which could completely explain the clinical problems. Additional necropsies of selected animals were more clarifying and disclosed the presence of osteomyelitis, *E. coli* septicemia, arthritis, and increased liver copper contents. Osteomyelitis has rarely been described in goats. In the osteomyelitis cases in this paper, initially no bacterial culture was performed since no abnormalities were seen macroscopically. Cultures from the macroscopically abnormal femurs of the additionally submitted goat kids were negative, most probably due to the use of antibiotics combined with sampling in a chronic stage. *E. coli* was, however, cultured from the chronic purulent inflammation observed in the rib of one animal and from two animals suffering from *E. coli* septicemia. *E. coli* septicemia is normally seen at a much younger age, predominantly under ten days.[4] In older animals, *E. coli* septicemia, which can be associated with arthritis and osteomyelitis, is seen as an opportunistic infection often in immune compromised animals,[4] and in this case, most probably via infection of the intestinal tract since next to *E. coli* also *E. hirae*, a commensal of the gastrointestinal tract,[5] was cultured from an overfilled knee joint in one animal. Feed changes, stress, and diarrhoea could have created the opportunity for invasion of these intestinal tract commensals leading to hematogenous spreading. Young animals are sensitive to infections of bone, specifically of long bones, which are highly vascularized and prone to infection by hematogenous spreading of bacteria. As bone lysis and periosteal reaction usually take place 10–21 days after the start of an inflammation,[6] the initial infection in these cases possibly took place 1.5–three weeks earlier, so most probably around the time of disbudding. Therefore, during the second farm visit predisposing factors were mapped and classified as environmental, iatrogenic, and decreased immune response related, and there was multiple evidence for the latter. Firstly, stress due to multiple simultaneous management procedures (Figure 2) and a high population density. Sevi et al.[7] suggested that goats have a difficult

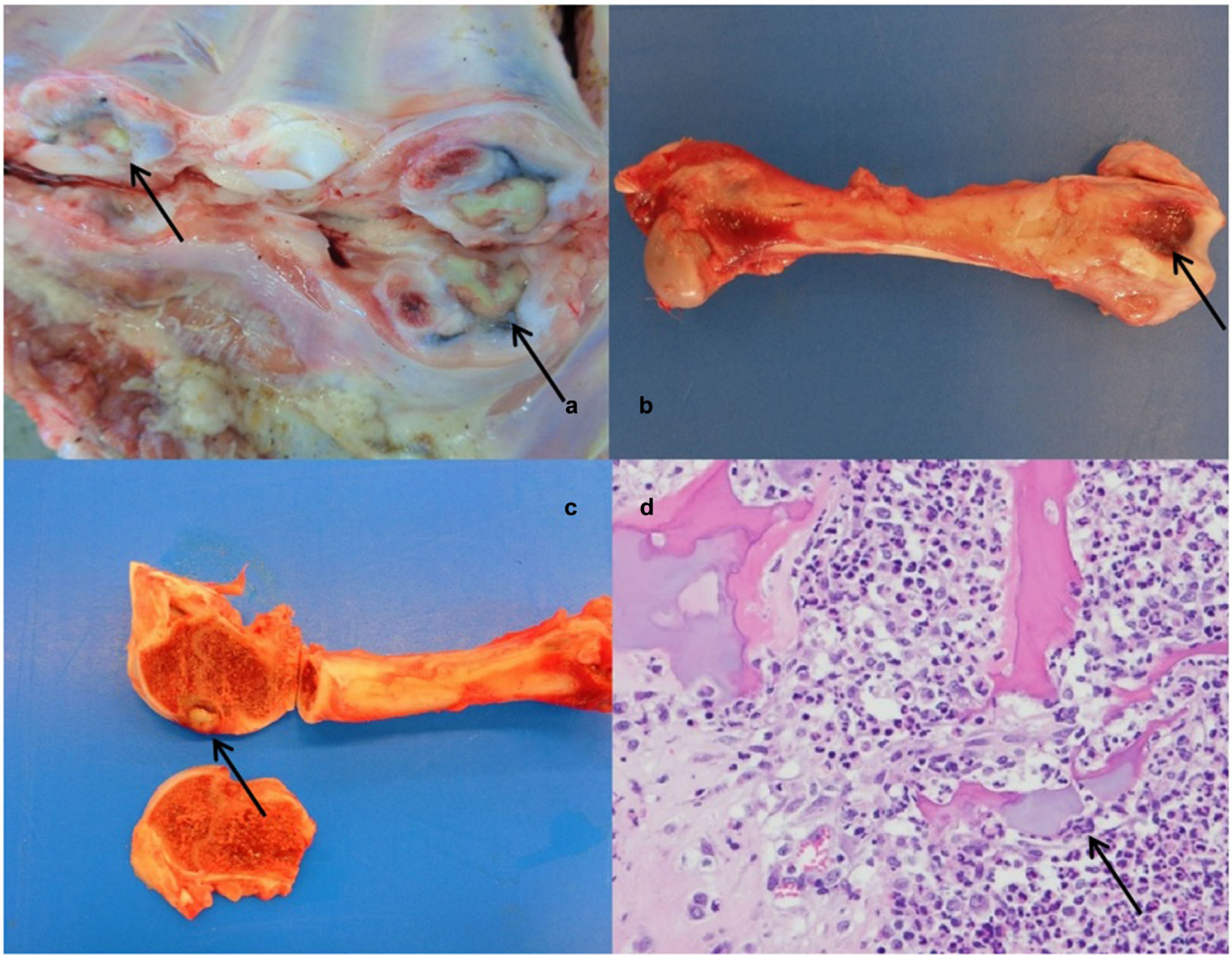

FIGURE 1 (a) Transition of rib to costal cartilage: Transverse section with foci of chronic purulent inflammation (arrows).(b) Femur: Large ulcerative lesion of the cartilage of the trochlear groove (arrow).(c) Femur: Distal longitudinal cut surface demonstrating chronic necopurulent inflammation (arrow).(d) HE stained histologic section of the femur demonstrating purulent osteomyelitis. Necrotic bone fragments (arrow) surrounded by neutrophilic granulocytes

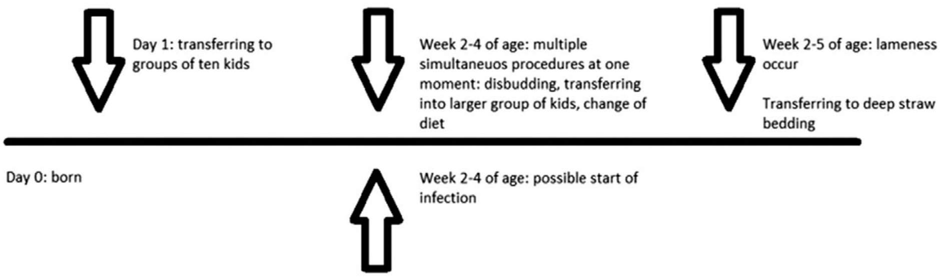

FIGURE 2 Multiple simultaneous management procedures in dairy kids.

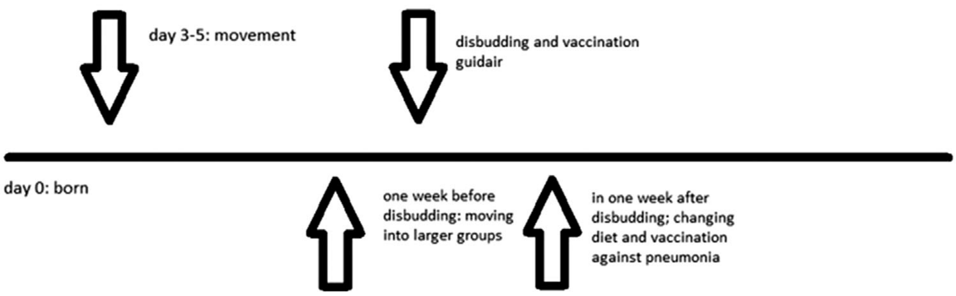

FIGURE 3 Advised procedure for reduction of multiple simultaneous management procedures in dairy kids (follow up)

adaptation to unfamiliar environments and integration with unknown groups. Secondly, improper dietary management: the high copper level in the liver (Table 1) could have resulted in a decreased immune response due to oxidative stress[2] and potential hepatocellular necrosis.[3] Thirdly, a better start for the kids using colostrum instead of colostrum replacer could result in healthier and stronger kids. Preventive use of antibiotics is strongly associated with acquired antimicrobial resistance.[8] Recent Dutch policies aim at reducing antimicrobial use. As a consequence, farmers and veterinarians have to improve management and to utilize alternative preventive measures like improvement of colostrum management, improvement of housing systems and ventilation, and the application of farm specific vaccination programs. In a recent study, antibiotic use in the small ruminant industry in the Netherlands appeared to be low, and the largest quantity of antibiotic use was observed in the professional goat industry. On the farm described in this paper, antimicrobial use was much higher compared to average and median use on professional Dutch goat farms.[9] Maintaining of a good hygienic standard is obligatory. Not changing needles between every treated kid could have easily transferred an infection from one kid to another. And ultimately, housing and ventilation during the rearing period should be of good quality to minimize infection pressure.

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