

Comparison of the effect of two different joint lavage techniques on survival rate in calves with septic arthritis: 248 cases



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SUMMARY

Septic arthritis, defined as joint inflammation, is common in newborn calves when the passive transfer of maternal immunoglobulins fails. An unhygienic environment, lack of umbilical care and insufficient colostrum after birth predispose to the formation of septic arthritis. Arthrotomy and through-and-through needle joint lavage techniques are employed in the management of septic arthritis. This study aimed to evaluate the effect of two different joint lavage techniques on survival rate in calves with septic arthritis presented to Atatürk University Veterinary Faculty Animal Hospital between 2018-2021. A total of 248 calves with septic arthritis were included in the study. One hundred twenty (48.4%) of the 248 calves had a complete bacterial analysis of the infected joint. Two different lavage methods (through-and-through needle [n = 138] and arthrotomies [n = 96]) were used for joint lavage. A through-and-through lavage method was performed on 138 calves. Out of these, 114 (82.6%) animals made a full recovery, while 24 (14.4%) were humanely euthanized or died. Conversely, arthrotomy was employed in 96 calves, with 81 (84.4%) animals making a full recovery, while 15 (15.6%) calves were humanely euthanized or died. Additionally, Of the 248 calves, 120 (48.5%) obtained a thorough bacterial examination of the affected joint. Eighty-nine out of 120 (74.1%) calves had at least one bacterial isolate found during bacterial culture. Two bacterial isolates were discovered from synovial samples of 31 (25.8%) calves. *Staphylococcus aureus* (30%), *Escherichia coli* (25.8%), *Trueperella pyogenes* (24.1%), and other pathogens (13.4%), including *Enterococcus* species, *Bacillus* species, *Proteus* species, and *Corynebacterium* species, were the most commonly isolated bacteria in the infected joint of calves. There was no statistically significant difference in the survival rates between the two joint lavage techniques (P = 0.72). The chances of success of treatment are related to whether the patient has been treated before, and the stage of the disease, but both treatment methods can be used successfully in the treatment of arthritis since the success rates are more or less the same.

KEY WORDS

Calves, Septic arthritis, Joint, Hematogenous.

INTRODUCTION

Septic arthritis is a very important disease that frequently affects newborn calves, especially within the first eight weeks of their life. It is thought to be the result of secondary bacterial colonization, especially in the joints affected by the disease. Especially common in newborn calves and is defined as a joint disease that causes by direct trauma, hematogenous dissemination, and extension of periarticular infections. It is a common cause of lameness, which is responsible for significant economic losses in the livestock and dairy industries (1,2). Systemic infections in calves may also be a cause of septic arthritis (2,3). Also, it can result from periarticular wound infection, inoculation of the joint by an open or puncture wound, and by

hematogenous or lymphomatous inoculation. The higher incidence of septic arthritis in calves is due born in an unhygienic environment, lack of disinfection of the umbilicus, and inadequate intake of colostrum in the first few hours after birth. An inflammatory response occurs in the infected joint. Microorganisms are destroyed by neutrophils and their enzymes such as collagenase, cathepsin, elastase, and gelatinase that come to the site (4,5). Which enzymes cause damage to joint components and cartilage tissues (6).

Early treatment in calves with septic arthritis significantly affects the prognosis of the disease. As the disease progresses, the chances of success decrease. Several methods for septic arthritis treatment have been described. Antibiotic and anti-inflammatory therapy, joint lavage, arthroscopy, arthrotomy, and arthrodesis methods are used in the treatment of septic arthritis. If there is no recovery in the joint after medical therapy, surgical methods may be a good option. Joint lavage is an effective invasive method, the application of which is based on surgical asepsis procedures in cases that do not respond to par-

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enteral antibiotic therapy (2,7). Arthrotomy, like arthroscopy, is indicated in very serious and chronic cases where joint lavage fails or medical treatment has a low chance of success. Surgical opening of the joint may be required when the presence of fibrin formations blocks. Surgical management serves as a supplement to medical treatment and attempts to relieve synovial pressure and bacterial strain (8). Joint lavage is aimed at irrigation and evacuation of infected contents in cases of purulent-septic arthritis. In chronic cases, joint lavage is insufficient, as the joint is often filled with compact fibrin. The prognosis is poor in cases with soft tissue, bone necrosis, and osteomyelitis. In such cases, the recommended treatment options can be listed as arthroscopy, arthrotomy, or arthrodesis (6,9,10,11).

Clinical signs of septic arthritis include lameness, distension, increasing heat, redness, and signs of pain during palpation of the affected joints. The diagnosis of septic arthritis is confirmed based on arthrocentesis findings (bacterial culture results, cytological assessment of synovial fluid, and biomarker measurement), ultrasonographic and radiographic examination of the affected joints (1,12).

There are insufficient data on the comparison of the arthrotomy and through-and-through joint lavage methods of septic arthritis in calves. This study aimed to compare the effect of arthrotomy and through-and-through joint lavage techniques on survival rate in 248 newborn calves with septic arthritis.

MATERIALS AND METHODS

The medical record database of the Atatürk University Veterinary Faculty of Animal Hospital was reviewed to identify the records of calves that were examined from 2018 through 2021 for which septic arthritis was diagnosed at ≤ 90 days old. Cases were divided into treatment groups according to clinical, radiographic, and ultrasonographic examination findings. The

exclusion criteria are specified in Table 1.

Clinical Examination

The general condition of the presented animals is slightly and moderately impaired. After the inspection and palpation examination, treatment options were applied as indicated in Table 1.

Radiographic Examination

A radiographic examination was performed on the anterior-posterior and latero-medial positions of the infected joints. For the examination were used a stationary X-ray machine (Mex-100, Oberhausen-Germany). In acute cases, the presence of radiolucent area in the joint and increased joint space were observed. In chronic cases, decreased joint gap, bone lysis on the subchondral joint surface, periosteal reaction, and bone proliferation were observed.

Ultrasonographic Examination

The affected joints were shaved, cleaned, and contact gel was used before the ultrasonographic examination. Joints were investigated by using a 5 MHz sector and 7.5 MHz linear probes (GE Vivid S6, Milwaukee, USA). No anesthetic drug was used during both examinations. In some cases, on ultrasonographic examination, the joint contents were seen as hyperechogenic and anechogenic areas. Again, in cases, fibrin structures were determined from mild to severe.

Microbiological Examination

Before the infected joint treatment, calves were administered with intramuscular 40 $\mu\text{g}/\text{kg}$ detomidine (Domosedan, Zoetis, NJ, USA). The affected joint was prepared for aseptic conditions using standard sterilization procedures. A sterile puncture of the affected joint using a 16-gauge needle was performed and 2 ml synovial fluid was collected with a 2.5 ml syringe.

To determine the presence of *Mycoplasma* spp. in the samples,

Table 1 - Clinical radiographic and ultrasonographic findings of 248 newborn calves with septic arthritis.

Selection Criteria	Through-and-Through Lavage	Arthrotomy	Excluded Patients
Clinical Findings			
Duration of Disease	1-2 weeks	2- 12 weeks	12 > weeks
Distension of Joint Compartments	Mild	Mild or moderate	Profound
Grade of Lameness	1-2/5	3-4/5	5/5
Joint Content	Suppurative or lightly fibrinous	Severe fibrinous	Caseified
Radiographic Findings			
Joint Content	Radiolucent areas and increased joint range	Decreased joint range, bone lysis on the subchondral joint surface, periosteal reaction, and bone proliferation	Bone fracture, Ankylosis
Ultrasonographic Findings			
Joint Content	Hyperechoic or mixed aspect of the fluid joint	Mixed echogenicity flow phenomena	
Bone Surface	Regular articular surfaces	Mild or moderate irregular bone surface	Several irregular bone surfaces
Bone Loss	No bone destruction	Mild or moderate bone destruction	Advanced bone destruction

they were inoculated into Mycoplasma selective medium. The medium contains yeast extract, thallium acetate, penicillin G, and phenol red solutions. For routine isolation of Mycoplasma, the specimen should be inoculated into broth and agar. The inoculated medium (broth and agar) is incubated in a humid atmosphere at 37 °C, under 5% CO₂, and 48 and 96 hours. The Petri dishes are viewed under a stereoscopic microscope or the low-power objective of a light microscope, for the characteristic mycoplasmal 'fried-egg' microcolonies. The cultures can be regarded as negative if no microcolonies are seen after 14 days of incubation.

For routine diagnosis, two milliliters of synovial fluid were inoculated onto Columbia agar with 7% defibrinated sheep blood and MacConkey agar. Specimens plates were incubated at 35 ± 2 °C in a normal atmosphere for 24 to 48 hours. The morphological and hemolytic characteristics of the colonies, catalase, coagulase, and oxidase tests, gram staining, and specific biochemical assays were used to identify any growth on agars. According to the Clinical Laboratory Standards Guide, antibiotic susceptibility testing was performed using the Agar Disc Diffusion technique. The colonies were suspended in a 0.9% NaCl saline solution. Turbidity was corrected to the 0.5 McFarland standard (approximately 108 CFU/mL) and utilized as the antibiotic test inoculum. Following that, 0.1 mL of bacterial solution was put over Muller Hinton agar, followed by antibiotic disks. Disks containing Amoxicillin-clavulanic acid (20/10 g), ampicillin-sulbactam (10/10 g), streptomycin (10 g), tetracycline (30 g), trimethoprim (5 g) were collected from Oxoid® (Hampshire, England) and plates were incubated at 37 °C for 24 h. According to the Clinical Laboratory Standards Guide, inhibition zones were assessed and classified as susceptible, moderately resistant, or resistant.

Treatment

Medical treatment

Amoxicillin-clavulanic acid (10 mg/kg, Intramuscular (IM), q 24 h) or Marbofloxacin (2 mg/kg, IM, q 24 h) were administered for antibiotic therapy for 5 days until culture results were obtained. For anti-inflammatory effects, Flunixin meglumine (2.2 mg/kg, IM, q 24 h) was applied for 3 days during the treatment.

Through-and-Through Joint Lavage

The a-16-gauge needle was inserted into the two opposite points of the involved joint until reaching the synovial membrane. Then, a large volume of NaCl 0.9% (Bioflex, Istanbul, Turkey) solution was used for joint lavage. To create pressure in the joint, the synovial sac was inflated at some times by grabbing the caudal outlet. The joint contents were completely evacuated. In cases deemed necessary, the procedure was repeated 2 to 3 times. Joint lavage was continued until the aspirated fluid becomes clear. No bandage was applied after the procedure.

Arthrotomy

The animals were placed on the operating table in the lateral position. The involved joint was shaved circularly. The joint area was washed to remove solid dirt. Then, povidone-iodine was used for antisepsis. Detomidine (Domosedan, Zoetis, NJ, USA) at a dose of 80 mcg/kg was used for sedation, and intravenous (IV) 2 mg/kg ketamine hydrochloride (Ketasol, Interhas, Turkey) was used for general anesthesia. General anesthesia was maintained with boluses of ketamine hydrochloride

IV administered every 20 minutes at the initial dosage. The procedure was started with a 1-2 cm incision using the number 12 scalpel of the relevant joints. After skin and muscle incisions in the region, the synovial membrane was incised to approach the joint. Fibrinous or purulent contents and destroyed bone fragments in the infected joint were removed by gentle curettage. The joint chambers were debrided continuously with isotonic saline solution throughout the entire procedure. After arthrotomy, the incision sites were not closed to allow drainage. The area was protected with a window bandage. During this procedure, the tendons, adjacent ligaments, vessels, and nerves were protected from trauma.

Outcome

The calves were not hospitalized. If the patient performed following the owner's expectations 1 year after discharge from the hospital, the long-term result was considered positive. This information was obtained by a researcher by calling the patient owners by phone. The result was defined as negative if the calf died in the hospital or afterward, was euthanized, or did not meet the owner's expectations during the telephone survey.

Statistical Analysis

All data were analyzed using Medcalc version 20.011 (Medcalc Software, Ostend, Belgium) and values of <0.05 were considered significant. The results of different lavage techniques on survival rate were also compared by chi-square analysis. The results of the treatment of calves with septic arthritis are presented.

RESULTS

The study was conducted on 248 cases. All of the cases were evaluated clinically, radiographically, and ultrasonographically as in Table 1. Joint radiographs were determined abnormal in 182 (73.4%) cases, including periarticular soft tissue swelling, decrease or increase in joint space, bone proliferation, and subchondral lysis. The ultrasonographic examination was performed in 40 (16.1%) calves and inflammatory effusions with varying echogenicity-echogenicity were found.

A total of 234 animals were treated with either thorough-and-through lavage or arthrotomies. A through-and-through lavage method was performed on 138 calves. Out of these, 114 (82.6%) animals made a full recovery, while 24 (14.4%) were humanely euthanized or died. Conversely, arthrotomy was employed in 96 calves, with 81 (84.4%) animals making a full recovery, while 15 (15.6%) calves were humanely euthanized or died. There was no statistically significant difference in the survival rates between the two joint lavage techniques ($P = 0.72$). Twelve animals (4.8% of the total 248) were excluded from the study groups due to severe calcified joint content, advanced bone destruction, and refusal of treatment by the animal owners. One hundred twenty (48.4%) of the 248 calves had a complete bacterial analysis of the infected joint. During bacterial culture, eighty-nine of 120 (74.1%) calves had at least one bacterial isolate identified. Thirty-one (25.8%) calves had two bacterial isolates identified from synovial specimens. The most isolated bacteria in the infected joint of calves was *Staphylococcus aureus* (30%), followed by *Escherichia coli* (25.8%), *Trueperella pyogenes* (24.1%), and other pathogens (13.4%) such as *Enterococcus spp.*, *Bacillus spp.*, *Proteus spp.*, and *Corynebacterium spp.*

DISCUSSION

Septic arthritis, commonly observed in calves, results from umbilical disease or deficiency of passive transfer of maternal immunoglobulins after birth or postnatal trauma (1). The current study evaluated that calves aged less than 3 months with septic arthritis presented to Ataturk University Animal Hospital were described. Lameness, swelling, pain, hyperthermia, and loss of appetite are common clinical findings in calves with septic arthritis (1,6,13). In this study, all of these clinical findings were present.

A total of 248 calves were diagnosed using ultrasonography or radiography examination in this study. Although radiography and ultrasonography are considered specific in the diagnosis of septic arthritis, no abnormalities were detected on ultrasonography or radiography of the joints of 20 calves with septic arthritis. The most common radiographic findings of infected joints were increased or decreased joint space, bone proliferation, periarticular soft tissue swelling, and subchondral lysis in this study, and were similar to those reported in the previous studies in calves with septic arthritis (7,14,15).

Joint lavage is an important treatment method in the treatment of septic arthritis. Aggressive antibiotic therapy, along with joint drainage and/or lavage can be effective in early cases, but arthroscopy is considered to give better results in any chronic cases or severe infections (16). In this study, the through-and-through joint lavage method was used in calves aged 1-2 weeks and the arthroscopy method was used in calves aged 2-12 weeks. Experimental studies have shown that fibrin clots develop in the joint after the seventh day (17). But depending on the severity of the disease, it may be necessary to use different lavage methods. The most effective way to remove the formed fibrin clots is arthroscopy. Arthroscopy allows precise debridement of tissues inside the joint, and removal of infected synovia, bone, and bone fragments. The success of the arthroscopy method is higher than other applications. Therefore, in this study, the arthroscopy method was preferred in animals aged 2-12 weeks with dense fibrin accumulation. In severe cases, total curettage and arthrodesis performed to ensure immobilization of the joint give successful results. But joint immobilization is not recommended in young animals (17). Arthroscopy, which is another surgical method, is limited in chronic cases. Because the fibrin in the joint can impair vision and manipulation. On the contrary, arthroscopy provides better access to all joint faces. Increases the success in the removal of exudate and necrotic tissues. However, the surgical approach is difficult because of its proximity to adjacent tissues such as muscles, vessels, and nerves (2).

As reported in previous studies (13,18), at least one bacterial pathogen was identified in joints with septic arthritis in 120 of the 248 (48.4%) calves in the current study. The most isolated bacteria in infected joints were *Staphylococcus aureus* (30%), followed by *Escherichia coli* (25.8%), *Trueperella pyogenes* (24.1%), and other pathogens (20.1%) in calves, which seems similar to bacteriological findings in previous studies (13,19).

The treatment of septic arthritis includes reducing the bacterial load and preventing the increase in inflammation, and pain management. The bacterial load, the duration of the affected joint, and the disease are important for determining case management (1). The successful treatment for septic arthritis is the removal of purulent debris from the infected joint. There are

several techniques described in calves including tidal irrigation, through-and-through needle lavage, performing arthrotomies, or flushing the joint under arthroscopic guidance. As mentioned in previous studies, needles were inserted into the bulging joint while applying joint through-and-through joint lavage. A previous study conducted on humans with septic knee arthritis reported that needle aspiration and arthrotomies method did not cause a change in survival rate (20). Similarly, the current study stated that there was no difference between through-and-through needle lavage and arthrotomies in the survival rate. A lot of biomarkers have been studied in vacationing the diagnosis and prognosis in cases of septic arthritis (1). Although bacterial culture and antibiogram analysis were performed in our study, synovial fluid analysis, hematological analysis, and total nucleated cell count analyses from synovial fluid could not be performed.

In this study, the survival rate of through-and-through joint lavage and arthroscopy, which are one of the treatment options, were evaluated on calves. No significant difference was found between the effect of the two methods on survival rate. As a result, the success rate of joint lavage methods in the treatment of calves with septic arthritis is increased by early diagnosis and treatment. The choice of treatment method should be decided by clinical, radiographic, and ultrasonographic examination findings. The chance of success of the treatment is related to the stage of the disease, whether the patient has been treated before or not, and scientific studies should be conducted on more animal numbers and species to compare the success of these two different treatment methods.

Author's contribution

ÖTO, YK, and SO conceptualization, investigation, data curation, writing-original draft preparation, formal analysis; LEY, MGS and UE, supervision, writing – review & editing, methodology, investigation, visualization; CÖ, MFK, and AE supervision, visualization, and microbiological analysis.

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Declaration of Competing Interest

The authors declare no conflict of interest.

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