Bacterial colonization of intravenous catheters in young dogs suspected to have parvoviral enteritis

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Objective—To determine the prevalence of bacterial colonization of IV catheters among young dogs suspected to have parvoviral enteritis, to identify the organisms responsible for catheter colonization, and to determine the antimicrobial susceptibility of organisms that were obtained.

Design—Case series.

Animals—100 dogs.

Procedure—Catheters were aseptically removed when fluid therapy was discontinued, the catheter was replaced, or the dog died. The distal tip of the catheter was cut off, split open, and vortexed with sterile saline (0.9% NaCl solution). The saline solution was plated on culture plates, which were then incubated and examined for bacterial growth every 24 hours for 72 hours. All bacteria cultured were identified, and antimicrobial susceptibility was determined.

Results—Bacteria were isolated from 22 catheters. Most bacteria that were isolated were of gastrointestinal tract or environmental origin (Serratia odorifera, Staphylococcus liquefaciens, S marcescens, Acinobacter amitratus, Citrobacter freundii, Klebsiella pneumoniae, K oxytoca, Escherichia coli, Enterobacter spp). Only 2 gram-positive organisms were isolated (Staphylococcus intermedius and Streptococcus spp). High percentages of organisms were resistant to penicillin, lincomycin, cloxacillin, erythromycin, and cephalaxin. Percentages of organisms resistant to amikacin, enrofloxacin, chloramphenicol, potentiated sulfonamides, and amoxicillin-clavulanic acid were low.

Conclusions and Clinical Relevance—Results suggest that IV catheters may be colonized with bacteria in 22% of young dogs suspected to have parvoviral infection. (J Am Vet Med Assoc 2002;220:1321–1324).

A previous study reported that 11 to 28% of indwelling IV catheters used in human patients in an intensive care unit were found to be colonized by bacteria after removal of the catheter. This high prevalence is of particular concern, because some percentage of patients with bacterial colonization of IV catheters will go on to develop catheter-related infections or catheter-related sepsis. In human patients, the incidence of catheter-related infection is 4 to 14%, with a mortality rate as high as 20% and a complication rate as high as 32% in affected patients. The incidence of catheter-related infection in veterinary medicine remains largely unknown, although there is a perception in the veterinary literature that the incidence is low.

Bacterial contamination of catheters in critically ill animals has been speculated to increase morbidity and mortality rates. In addition, bacterial colonization of indwelling IV catheters is considered a potential precursor of catheter-related infection. Thus, various studies have attempted to determine the prevalence of bacterial colonization of IV catheters used in dogs and cats. In a study of 88 critically ill dogs, for instance, the incidence of bacterial colonization of IV catheters ranged from 15 to 48%, and the organisms most commonly isolated were Escherichia coli, Aerobacter spp, Proteus spp, and Klebsiella spp. In another study of animals in a small animal intensive care unit, 26% of IV jugular catheters were positive for bacterial growth. The organisms most commonly isolated in that study were enteric organisms. In a study of dogs and cats receiving total parental nutrition, 7% of the catheters were positive for bacterial growth.

The purpose of the study reported here was to determine the prevalence of bacterial colonization of IV catheters among young dogs suspected to have parvoviral enteritis, to identify the organisms responsible for catheter colonization, and to determine the antimicrobial susceptibility of organisms that were obtained.

Materials and Methods

The experimental protocol was approved by the Ethics and Research Committees of the Faculty of Veterinary Science, University of Pretoria. One hundred client-owned dogs admitted to the isolation unit of the Onderstepoort Veterinary Academic Hospital were enrolled in the study. Dogs with clinical signs of parvovirus infection (ie, dehydration, hemorrhagic feces or vomitus, and leukopenia in conjunction with a history of incomplete or no vaccination against parvovirus infection) in which an indwelling IV catheter had been placed in a central or peripheral vein were eligible for inclusion in the study. When possible, a fecal sample was examined for viral particles by means of electron microscopy to confirm the clinical diagnosis. All dogs were treated according to a standard protocol for suspected parvoviral infection.

For each dog, an IV catheter removed at the time fluid therapy was discontinued, the catheter was replaced, or the dog died was submitted for bacterial culture. All catheters used in the study were removed by 1 of the authors. The duration that the catheter was in place; the type, size, and placement site of the catheter; and the identities of all antimicrobials and fluids administered through the catheter were recorded.

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Catheters were aseptically removed, and the distal 15 to 20 mm of each catheter was cut off with a sterile scissors and placed in a sterile culture bottle. Within 2 hours, the catheter was cut longitudinally with a sterile scissors and placed in 0.1 ml of sterile physiologic saline solution. The solution was vortexed for 30 seconds, and a sterile cotton-tipped swab was then dipped in the solution and swabbed along the edges of the catheter. The swab was streaked on a plate containing Columbia blood agar base supplemented with 7% horse blood and a second plate containing MacConkey agar with salt but without crystal violet. The blood agar plate was incubated at 37°C in 5% carbon dioxide and air; the MacConkey agar plate was incubated at 37°C in air. Plates were examined for bacterial colonies after 24, 48, and 72 hours of incubation. Each morphologic colony type was subcultured on blood and MacConkey agar plates for identification. Gram-negative bacteria were identified with an automated system. Gram-positive bacteria were identified on the basis of shape, catalase reactivity, results of a coagulase test for staphylococci, and results of Lancefield wall antigen typing for streptococci. Further characterizations were made on the basis of results of sugar fermentation tests. Antimicrobial susceptibility of each isolate was determined with the Kirby-Bauer disk diffusion method, following the protocol recommended by the National Committee for Clinical Laboratory Standards.

Nosocomial infection surveillance was performed monthly by swabbing counter surfaces and cages in the isolation unit with sterile cotton-tipped swabs. Bacterial culture techniques were the same as those used for the IV catheters.

**Data analysis**—Results were tabulated in a spreadsheet program. Descriptive statistics were used to describe the data. The t-test and Mann Whitney rank sum test were used to test for significant differences between colonized and noncolonized catheters with regards to signalment, catheter type, catheter site, duration of time that the catheter was in place, antimicrobials administered, and antimicrobial susceptibility. The Pearson product correlation method was used to test for correlations between variables. All statistical analyses were performed with the aid of a statistical software package. For all analyses, values of P < 0.05 were considered significant.

**Results**

One hundred catheters were collected. Ninety of the catheters had been placed in the cephalic vein, 9 had been placed in the jugular vein, and 1 had been placed in the saphenous vein. Ninety-nine of the catheters were from a single manufacturer; the remaining catheter was from a different manufacturer. Median time that catheters had been maintained in place was 3 days (range, 1 to 8 days). Reasons for removal of the catheter were death of the dog (n = 6), replacement of the catheter (16), and discontinuation of fluid therapy (78).

Median age of the dogs was 14 weeks (range, 5 to 36 weeks). There were 45 females and 55 males representing 17 breeds. Electron microscopy was performed on feces from 81 dogs; results were positive for 68 and negative for 13. Electron microscopy was not performed on feces from the remaining 19 dogs because of financial constraints. Electron microscopy was performed on feces from 5 of the 6 dogs that died; results were positive for all 5. Median rectal temperature at time of removal of the catheter was 38.6°C (101.5°F; range, 35 to 40.6°C [95 to 105.1°F]). Results of bacterial culture (positive vs negative) were not correlated with rectal temperature, outcome (survived vs died), or results of electron microscopy for parvovirus particles (positive vs negative).

Bacteria were cultured from 22 of the 100 catheters. Dogs for which results of bacterial culture of the IV catheter were positive did not differ significantly from dogs for which results were negative with regard to rectal temperature at the time of catheter removal, outcome, age, or results of electron microscopy of feces for parvovirus particles. However, time that the catheter was in place was significantly longer for dogs with positive bacterial culture results (mean ± SD, 4.59 ± 1.76 days) than for dogs with negative bacterial culture results (3.57 ± 1.31 days).

Two dogs were receiving fluids IV at a maintenance rate, 7 were receiving lactated Ringer’s solution at a replacement rate, and 81 were receiving lactated Ringer’s solution supplemented with potassium chloride (20 mmol/L) and glucose (20 ml of a 50% solution/L) at a replacement rate. All 100 dogs received amoxicillin (20 mg/kg [9.1 mg/lb], IV, q 12 h). Eighteen dogs received gentamicin (7 dogs at a dosage of 4 mg/kg [1.8 mg/lb], IV, q 24 h; 4 dogs at a dosage of 2 mg/kg [0.9 mg/lb], IV, q 24 h; 4 dogs at a dosage of 2 mg/kg, IV, q 12 h; 2 dogs at a dosage of 3 mg/kg [1.4 mg/lb], IV, q 12 h; and 1 dog at a dosage of 2 mg/kg, IV, q 8 h). Three dogs received metronidazole (20 mg/kg, IV, q 12 h), and 3 received enrofloxacin (5 mg/kg [2.3 mg/lb], SC, q 24 h).

Of the 22 catheters with positive bacterial culture results, 15 yielded a single organism, 3 yielded 2 organisms, 3 yielded 3 organisms, and 1 yielded 4 organisms. Organisms that were isolated included *Serratia odorifera* (5), *S liquefaciens* (5), *S marcescens* (3), *Acinobacter anitratus* (3), *Citrobacter freundii* (2), *Staphylococcus intermedius* (1), *Streptococcus spp* (1), *Klebsiella pneumoniae* (4), *K oxytoca* (1), *Escherichia coli* (8), and *Enterobacter spp* (1). Of these, only 2 (6%) were gram-positive bacteria. The remainder were generally common intestinal inhabitants of dogs and bacteria widely distributed in nature. Antimicrobial resistance varied widely. Two were resistant to amikacin, 18 were resistant to amoxicillin, 4 were resistant to amoxicillin-clavulanic acid, 21 were resistant to cephalaxin, 6 were resistant to chloramphenicol, all 34 were resistant to cinoxacin, 9 were resistant to doxycline, 31 were resistant to erythromycin, 8 were resistant to gentamicin, 33 were resistant to penicillin, 19 were resistant to nitrofurantoin, 7 were resistant to piperacillin, and 6 were resistant to trimethoprim-sulfamoxole. Twenty-seven were tested for resistance to enrofloxacin, and 3 were resistant. Twenty-nine were tested for resistance to lincomycin, and 28 were resistant.

All dogs for which results of bacterial culture of the IV catheter were positive survived. Only 1 dog developed a possible catheter-related infection. In this dog, the limb in which the catheter had been placed became swollen.

**Discussion**

Results of the present study suggest that IV catheters may be colonized with bacteria in 22% of young dogs suspected to have parvovirus infection.
This is similar to catheter colonization rates reported for humans and critically ill dogs. In humans, the organisms most commonly implicated as causes of catheter-related sepsis are commensal organisms from the skin. In the present study, however, and in previous studies of dogs, enteric and environmental bacteria were most commonly isolated. These bacteria can colonize the skin, as well as spread hematogenously. Only 1 skin commensal organism (Streptococcus spp) was isolated in the present study. All the bacteria isolated have been responsible for nosocomial infection in animals, with many of them being able to resist clinically useful antimicrobials or able to acquire resistance. Escherichia coli is a common opportunistic pathogen in most animal species and humans. Species of Serratia organisms isolated in the present study are considered to be of low pathogenicity in clinically healthy humans and animals; however, in debilitated patients they can result in nosocomial infections. In a previous report, IV catheters were thought to be the portal of entry of S marcescens, K pneumoniae, and Enterobacter spp in a dog and a cat with generalized sepsis, arthritis, and osteomyelitis. Although not proven, prolonged administration of fluids for liver disease may have resulted in a bacteremia and subsequent osteomyelitis caused by K pneumoniae in a German Shepherd Dog. Serratia marcescens is commonly isolated from the urine of human patients with an indwelling urinary catheter and, in the absence of symptoms, is often regarded as a contaminant. Given that vomiting and diarrhea are so common in dogs with parvovirus infection, we speculate that the gram-negative bacteria isolated in this study originated from the dog’s own intestinal tract. High percentages of these organisms were resistant to penicillin, lincomycin, cloxacillin, erythromycin, and cephalaxin. In a prospective 6-month study performed in a pediatric intensive care unit, Acinetobacter spp, E coli, and Klebsiella spp were the organisms most commonly found to be colonizing IV or venous cutdown catheters. Most of these organisms were susceptible to ciprofloxacin and amikacin, and few were susceptible to cefazolin and amoxicillin. In the present study, most of the organisms were susceptible to amikacin, enrofloxacin, chloramphenicol, potentiated sulfonamides, and amoxicillin-clavulanic acid. Although metronidazole was administered to some dogs in this study, susceptibility to this antimicrobial was not tested, as it is only effective against obligate anaerobic bacteria. The percentage of organisms resistant to amoxicillin was fairly high, most probably because this drug is mainly effective against gram-positive bacteria. However, its common use may be associated with plasmid-associated resistance in normal enteric and environmental microflora. The percentage of organisms resistant to gentamicin was also higher than what would be expected for gram-negative bacteria. Because not all of the organisms isolated were susceptible to any 1 antimicrobial, it is important in animals with IV catheter-related infections to submit samples for bacterial culture and susceptibility testing.

A study of 57 human patients in an intensive care unit that developed an episode of catheter-related infection and bacteremia failed to demonstrate any effect on mortality rate. Nevertheless, these infections led to an increase in hospital stay of approximately 20 days with associated additional costs. Major risk factors predisposing to catheter-related infections include prolonged duration of catheter placement, frequent manipulation of the catheter, use of thrombogenic catheter material, location of the catheter, and use of occlusive transparent plastic dressings.

In the present study, time that the catheter was in place was significantly longer for dogs with positive bacterial culture results than for dogs with negative results, which is similar to findings in human patients. However, results of bacterial culture of the IV catheter were not associated with outcome, which is in agreement with results of some previous studies but different from results of a study involving animals receiving total parental nutrition in which catheter-related infection was associated with increases in morbidity and, possibly, mortality rates. In a study of human patients with central venous, pulmonary artery, and arterial catheters, the incidence of catheter-related sepsis was similar when catheters were removed every 7 days or left in place as long as the catheter remained functional.

In humans, catheter-related infection ranks as 1 of the most frequent and, potentially, most lethal nosocomial infections. To rule out the possibility that bacteria that were isolated from the IV catheters in the present study were acquired from the hospital environment, monthly nosocomial infection surveillance was done in the isolation unit. At all times during the study, bacteria isolated from the catheters were different from the bacteria isolated during nosocomial infection surveillance.

Catheter-related bacteremia is heralded by spiking fever, malaise, and rigors. However, none of the dogs in the present study had any of these clinical signs, and catheter-related infection was suspected in only 1 that developed phlebitis in the limb that was catheterized.

References


