Survey of complications and antimicrobial use in equine patients at veterinary teaching hospitals that underwent surgery because of colic

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Objective—To determine current practices regarding use of antimicrobials in equine patients undergoing surgery because of colic at veterinary teaching hospitals.

Design—Survey.

Sample Population—Diplomates of the American College of Veterinary Surgeons performing equine surgery at veterinary teaching hospitals in the United States.

Procedure—A Web-based questionnaire was developed, and 85 surgeons were asked to participate. The first part of the survey requested demographic information and information about total number of colic surgeries performed at the hospital, number of colic surgeries performed by the respondent, and whether the hospital had written guidelines for antimicrobial drug use. The second part pertained to nosocomial infections. The third part provided several case scenarios and asked respondents whether they would use antimicrobial drugs in these instances.

Results—Thirty-four (40%) surgeons responded to the questionnaire. Respondents indicated that most equine patients undergoing surgery because of colic at veterinary teaching hospitals in the United States received antimicrobial drugs. Drugs that were used were similar for the various hospitals that were represented, and for the most part, the drugs that were used were fairly uniform irrespective of the type of colic, whereas the duration of treatment varied with the type of colic and the surgical findings. The combination of potassium penicillin and gentamicin was the most commonly used treatment.

Conclusions and Clinical Relevance—Results of this study document the implementation of recommendations by several authors in veterinary texts that antimicrobials be administered prophylactically (ie, before surgery) in equine patients undergoing surgery because of colic. The decision on whether to administer antimicrobials prophylactically to equine patients undergoing surgery because of colic should be made on the basis of the expected degree of contamination of the abdomen and surgical incision, the general health and immune status of the patient, the expected duration and type of surgical procedure to be performed, the potential risk of adverse reactions, and the cost of the drugs to be used. In addition, the risk of selecting for antimicrobial resistance among pathogens and commensal organisms should be considered.

Available data suggest that in humans undergoing clean-contaminated surgery (ie, in which the gastrointestinal tract is entered under controlled conditions and spillage of intestinal contents or contamination is judged to be minor), prophylactic antimicrobial administration should be continued for ≤ 24 hours. To our knowledge, few studies have examined the efficacy of prophylactic antimicrobial administration in large animal patients. One study did find that cattle undergoing rumenotomy that received antimicrobials prophylactically returned to feed sooner and had fewer surgical site abscesses and infections than did cattle that did not receive antimicrobials. However, surgical intervention or euthanasia is required.

In equine medicine, the term colic refers to a variety of conditions ranging from those that resolve without medical intervention to those that are so severe that veterinary intervention or euthanasia is required. An exploratory celiotomy is often performed to determine the cause and, potentially, resolve the problem in horses with colic. In some instances, the problem is such that an enterotomy is not required for removal of devitalized bowel or bowel decompression, and thus, the risk of contamination of the abdomen and surgical incision is minimal. More often, however, an enterotomy is required. In these instances, even though entry into the lumen of the gastrointestinal tract is controlled, minimizing spillage of intestinal contents, contamination of the abdomen and surgical incision is more likely.

The Committee on Trauma of the National Research Council has defined abdominal surgery involving bowel resection or entry into the gastrointestinal tract lumen under controlled conditions with no more than minor spillage of intestinal contents or contamination as a clean but contaminated procedure. Thus, colic surgery in equids is 1 of the most likely surgeries to result in contamination by bacteria of enteric origin.

Given that it is generally unclear, prior to surgery, whether enterotomy will be required and given that extensive research has indicated that antimicrobials are most effective when administered within 1 hour of bacterial inoculation, several authors have suggested that antimicrobials be administered prophylactically (ie, before surgery) in equine patients undergoing surgery because of colic. The decision on whether to administer antimicrobials prophylactically to equine patients undergoing surgery because of colic should be made on the basis of the expected degree of contamination of the abdomen and surgical incision, the general health and immune status of the patient, the expected duration and type of surgical procedure to be performed, the potential risk of adverse reactions, and the cost of the drugs to be used. In addition, the risk of selecting for antimicrobial resistance among pathogens and commensal organisms should be considered.
optimal duration of perioperative antimicrobial administration was not determined, and little has been published on the efficacy of perioperative antimicrobial administration in equine patients undergoing surgery because of colic.

Although the AVMA has developed and distributed guidelines for the judicious use of antimicrobials by veterinarians, to our knowledge, there have been limited surveys to date to determine the antimicrobial use practices of veterinarians. The purpose of the study reported here was to determine current practices regarding use of antimicrobials in equine patients undergoing surgery because of colic at veterinary teaching hospitals in the United States. In addition, we wanted to determine how frequently equine surgeons considered problems relating to antimicrobial resistance when selecting antimicrobials for use in equine patients, whether equine surgeons had standard antimicrobial use guidelines at their clinics, how frequently equine patients at veterinary teaching hospitals developed various infection problems, and how frequently equine patients with colic at veterinary teaching hospitals developed complications.

Materials and Methods

A Web-based survey on antimicrobial use in equine patients undergoing surgery because of colic at veterinary teaching hospitals was created with standard software. The questionnaire consisted of 47 multiple-choice or short-answer questions. The first part of the survey elicited demographic information about the respondents, such as state in which the veterinary teaching hospital at which they worked was located, number of equine colic surgeries that were performed annually at the veterinary teaching hospital where they worked, and number of equine colic surgeries that they personally performed annually. If the respondent was not performing equine colic surgery at the time of the survey, the survey was terminated. Additional questions in the first part of the survey pertained to whether there were written guidelines for antimicrobial drug use in equine patients undergoing surgery because of colic at their veterinary teaching hospital and whether all surgeons at their veterinary teaching hospital used the same antimicrobial drug regimen for these patients. The second part of the survey pertained to nosocomial (hospital acquired) infections. The third part of the survey provided several case scenarios. Respondents were asked whether they would use antimicrobial drugs in these instances and, if so, which drugs they would use and how long they would use them.

A draft of the questionnaire was pretested by 2 board-certified equine surgeons at different veterinary teaching hospitals who critiqued the accessibility and content of the questionnaire. The questionnaire was then modified on the basis of their input.

When the final questionnaire was ready, an e-mail message was sent to all equine surgeons board certified by the American College of Veterinary Surgeons who practiced at any of the 27 veterinary teaching hospitals in the United States, soliciting their participation. The list of potential participants was developed from the American College of Veterinary Surgeons Directory of Diplomates. Their e-mail addresses were obtained from the directory or from the university Web site where they practiced. The e-mail message described the study and provided the unique Web site address for the study, allowing participants to access the questionnaire directly via a hot link in the e-mail message. Each participant was given a randomly selected log-in number and password, ensuring security of access and allowing anonymous responses. Log-in numbers were tracked only to determine whether participants had submitted responses. The Colorado State University Human Research Committee approved this study prior to initiation. The software used to develop the questionnaire allowed participants to have secure access to the Web site and aided in compilation of the data.

Data were collected during a 3-week period during February 2000. Participants were sent 2 e-mail messages 1 week apart soliciting their participation. Responses submitted after the 3-week survey period were not included in analyses. At the time of this survey, there was limited availability of certain antimicrobials. Primarily there was a shortage of potassium penicillin. All participants were asked to complete the questionnaire on the basis of the antimicrobial drugs they used prior to this shortage. Participants were also asked to explain what changes, if any, they had made because of the perceived shortage.

Results

Demographic information for respondents—The initial e-mail notification was sent to 85 diplomates of the American College of Veterinary Surgeons working at the 27 veterinary teaching hospitals in the United States. Thirty-four (40%) of these individuals responded to the questionnaire. Responses were obtained from individuals working at 21 of the veterinary teaching hospitals in the United States. There were 5 hospitals with 3 respondents and 3 hospitals with 2 respondents; the remaining 13 hospitals each had a single respondent.

Of the 34 respondents, 20 (59%) indicated that they personally performed 1 to 25 equine colic surgeries annually, 8 (23%) indicated they performed 26 to 50 equine colic surgeries annually, 2 (6%) indicated they performed 51 to 75 equine colic surgeries annually, and 2 (6%) indicated they performed ≥ 101 equine colic surgeries annually. Two (6%) respondents indicated they did not personally perform equine colic surgeries, and additional responses from these 2 respondents were not included in subsequent data analyses.

Of the 32 respondents who personally performed colic surgeries, 14 (44%) indicated that 51 to 100 equine colic surgeries were typically performed at their hospital annually, 8 (25%) reported that 101 to 150 equine colic surgeries were typically performed annually, 5 (16%) reported that 151 to 200 equine colic surgeries were typically performed annually, 3 (9%) reported that ≥ 201 equine colic surgeries were typically performed annually, and 2 (6%) reported that 1 to 50 equine colic surgeries were typically performed annually at their hospital.

Written guidelines or standard protocols—Of the 32 respondents, 28 (88%) reported that they were not aware of any written guidelines or standard protocols for antimicrobial drug use for equine patients undergoing surgery for colic at their veterinary teaching hospital and that they were not aware of any uniform antimicrobial use practices by surgeons performing equine colic surgery at their veterinary teaching hospital.

Postoperative complications—Respondents were asked, for each of several specific conditions, whether the condition occurred at an above-average rate at their
hospital or was recognized to be a problem among any hospitalized equine patients (not limited to equine patients undergoing surgery because of colic) at their hospital. The criteria for considering whether the condition occurred at an above-average rate or was a recognized problem were not defined in the questionnaire. Salmonellosis was recognized as a problem by 11 of 32 (34%) respondents and occurred primarily between 1996 and 2000. Incisional infection in equine patients undergoing surgery because of colic was recognized as a problem by 8 (25%) respondents; however, there was no clear trend over time in the occurrence of incisional infections. Respondents indicated that incisional infections occurred sporadically between 1996 and spring 2000, with 1 respondent indicating that they were a problem from 1985 through 1996. Infection with *Enterococcus* spp or *Pseudomonas* spp was not recognized to occur in an above-average number of patients and was not considered to be a problem by any of the respondents. Only 1 respondent reported clostridial enteritis or diarrhea to occur in an above-average number of patients or to be a problem; the year it took place was not indicated. Infection with methicillin-resistant *Staphylococcus* spp was recognized as a problem by 8 (25%) respondents; these infections reportedly occurred between 1995 and 1999 as sporadic events. Four (12%) respondents indicated an above-average rate of occurrence of *Staphylococcus* spp infections for >3 consecutive years. Infection of wounds, catheter sites, and the respiratory tract with multidrug-resistant bacteria was recognized as a problem by 4 (12%) respondents. When respondents were asked to describe any other problems occurring at an above-average rate that they felt were worth reporting, 2 indicated that catheter-site infections and related problems with catheters occurred more often than expected, and 2 indicated that there was an above-average occurrence of diarrhea in their equine patients.

Respondents were asked to estimate the percentage of equine colic patients that developed postoperative complications between April 1999 and spring of 2000. Sixteen of the 32 (50%) respondents reported that 0 to 10% of equine patients undergoing surgery because of colic developed diarrhea. Twelve (37%) respondents stated that 11 to 20% of such patients developed diarrhea, and 4 (13%) reported that 21 to 40% of such patients developed diarrhea.

Thirty of the 32 (94%) respondents reported that 0 to 10% of equine patients undergoing surgery because of colic developed clinical evidence of peritonitis, and 2 (6%) reported that 11 to 20% of such patients had developed clinical evidence of peritonitis during the past 12 months. Twenty-seven (84%) respondents indicated that 0 to 10% of equine colic patients developed adhesions postoperatively, and 5 (16%) indicated that 11 to 20% did. Fifteen (47%) respondents estimated that 0 to 10% of equine colic patients developed incisional complications (infection, hernia, or both), 14 (44%) indicated that 11 to 20% did, and 3 (9%) indicated that 21 to 40% did.

Twenty-three (72%) respondents said 0 to 10% of equine patients undergoing surgery because of colic developed thrombophlebitis, 8 (25%) said that 11 to 20% did, and 1 (3%) said that 21 to 40% did. Twenty-three (72%) respondents indicated that 0 to 10% of equine patients undergoing surgery because of colic developed catheter-site infections during the postoperative period, and 9 (28%) indicated that 11 to 20% did.

Respondents were asked to list any other observed postoperative complications in equine colic patients. Laminitis was listed by 6 respondents as a postoperative complication, and in some instances, respondents indicated this occurred in up to 10% of these patients. Other complications that reportedly occurred in up to 10% of these patients included ileus, intestinal displacement, and endotoxemia. One respondent indicated that 20 to 40% of equine colic patients had gastric ulcers.

When asked whether they had changed their antimicrobial drug use patterns on the basis of 1 or more of these complications, 7 (22%) respondents answered that they had. Two indicated that they avoided using ceftriaxone, 1 used ampicillin instead of penicillin and used ceftriaxone less often, 1 used antimicrobials for prolonged periods, 1 had decreased the duration of antimicrobial drug use, 1 used metronidazole in addition to penicillin and gentamicin in patients with peritonitis or if peritoneal contamination had occurred during surgery, and 1 changed antimicrobials on the basis of results of bacterial culture and susceptibility testing.

**Antimicrobial drug resistance**—Participants were asked whether they had considered the issue of antimicrobial drug resistance among equine colic patients during the past 12 months. All but 1 participant indicated that they had thought about the issue; 13 (41%) thought about it once a week, 14 (44%) thought about it once a month, and 4 (12%) thought about it once a year. Fifteen (47%) respondents indicated that their veterinary teaching hospital had antimicrobial drug resistance monitoring programs, 10 (31%) were unsure whether their hospital had such a program, and 7 (22%) answered that they did not have such a program. Of 31 respondents, 19 (61%) stated that their veterinary teaching hospital had experienced problems with antimicrobial drug resistance in the past 3 years, 8 (26%) stated that their hospital had not experienced any problems, and 4 (13%) were unsure whether their hospital had any problems. For the respondents who practiced at veterinary teaching hospitals with a recognized antimicrobial drug resistance problem, the organisms implicated were *Staphylococcus* spp (12 respondents), *Salmonella* spp (8), *Enterococcus* spp (6), *Escherichia coli* (5), *Pseudomonas* spp (3), and *Clostridium* spp (1). Some respondents had more than 1 organism listed.

**Antimicrobial drug use**—All but 1 (97%) respondent reported that they routinely used antimicrobial drugs preoperatively in all equine patients undergoing surgery because of colic, irrespective of patient criteria. The 1 respondent who did not use antimicrobial drugs preoperatively in all equine patients used them in patients that were suspected to have peritonitis or compromised bowel. Twenty-seven (84%) of the respondents who routinely administered antimicrobial drugs preoperatively used potassium penicillin and
gentamicin. Other antimicrobial drugs that respondents listed as routinely used included penicillin (type not specified), procaine penicillin G (PPG) with gentamicin, and enrofloxacin. One respondent used all these antimicrobials at different times for selected cases.

In the third part of the questionnaire, respondents were asked to indicate which antimicrobial drugs they would use intra- or postoperatively for various surgical case scenarios on the basis of physical examination findings or findings during or after surgery. Of the 31 respondents who performed surgery on neonatal equine patients, 14 (45%) indicated they used potassium penicillin and gentamicin for 1 to 7 days, with most administering them for 24 to 72 hours. Some respondents listed > 1 antimicrobial combination. Other antimicrobial drugs listed were amikacin (12 respondents; 39%), PPG and gentamicin (2; 6%), ampicillin (2; 6%), ceftiofur (2; 6%), and ticarcillin (1; 3%).

For colic surgery in an adult horse without intestinal penetration, 25 (78%) of the respondents indicated that they used potassium penicillin and gentamicin during or after surgery, with duration of treatment ranging from a single dose to 5 days and with most administering them for 24 hours. One respondent listed using only penicillin. Three (9%) respondents reported that they used procaine penicillin and gentamicin. Two (6%) respondents reported that they did not use antimicrobial drugs intra- or postoperatively in these types of patients. The only other antimicrobial drug listed was trimethoprim-sulfonamide (TMS), which was listed by 1 respondent.

For adult horses requiring bowel decompression, 23 of the 32 (72%) respondents indicated that they would use potassium penicillin and gentamicin intra- or postoperatively, with duration of treatment ranging from a single dose to 5 days and with most administering them for 24 hours. Only 1 respondent used this combination of drugs for 5 days. Four (12.5%) respondents stated that they did not use antimicrobial drugs intra- or postoperatively in these patients, 1 (3%) respondent used penicillin alone, 3 (9.5%) respondents used PPG and gentamicin, and 1 (3%) respondent used TMS.

For adult horses undergoing colic surgery in which an enterotomy or enterectomy was performed, all 32 respondents indicated that they would use penicillin and gentamicin postoperatively, with duration of treatment ranging from 1 to 10 days; 3 (9.5%) respondents indicated they would use PPG, whereas the other 29 (90.5%) indicated they would use potassium penicillin. Other drugs listed by respondents as drugs they might use along with or instead of penicillin and gentamicin in selected cases were metronidazole (3 respondents; 9.5%), amikacin (1; 3%), enrofloxacin (1; 3%), and TMS (1; 3%).

In adult horses undergoing colic surgery with an iatrogenic tear of the serosa of the large colon, 24 of 32 (75%) respondents indicated that they would use potassium penicillin and gentamicin for 1 to 10 days postoperatively, with most indicating that they would administer antimicrobials for 3 days. In addition, 5 (15%) respondents reported they used metronidazole along with penicillin and gentamicin. Two (6%) respondents indicated they would use PPG with gentamicin. Two (6%) respondents stated that they would not use antimicrobials perioperatively, and 1 respondent indicated that “it did not matter.”

In horses undergoing intestinal resection and anastomosis, 29 (91%) respondents indicated they would use potassium penicillin and gentamicin for 1 to 7 days postoperatively, with most indicating they would use them for 5 days. Other antimicrobial drugs listed were metronidazole (4 respondents; 12.5%) in addition to other antimicrobials, PPG along with gentamicin (2; 6%), ampicillin with gentamicin and metronidazole (1; 3%), and enrofloxacin, which was listed by 1 (3%) respondent who also listed penicillin and gentamicin.

In adult horses in which bowel ischemia was identified during surgery, 30 (94%) respondents indicated they would use potassium penicillin and gentamicin for 1 to 10 days, with most indicating they would use them for 3 to 7 days. Two of these respondents indicated that although they would typically use potassium penicillin and gentamicin, it would depend on the degree of bowel damage and what was required in the way of surgical intervention. Two respondents indicated they would use PPG and gentamicin, with other antimicrobial drugs, including metronidazole in addition to penicillin and gentamicin, listed by 6 (18%) respondents.

In adult horses with large colon volvulus and ischemia, 28 of 32 (88%) respondents indicated they would use potassium penicillin and gentamicin for 1 to 10 days postoperatively, with most indicating they would use them for 5 days. Two (6%) respondents indicated they would use PPG and gentamicin, 1 (3%) respondent said he or she likely would either “pull out all stops or not pursue treatment,” and 1 (3%) respondent indicated he or she did not understand the question. Four (12.5%) respondents indicated they would use metronidazole in addition to penicillin and gentamicin.

In adult horses with peritonitis at the time of surgery, 28 of 32 (88%) respondents indicated they would use potassium penicillin and gentamicin for 1 to 14 days postoperatively or until the infection appeared resolved (horse was clinically normal or results of testing of abdominal fluid were normal), and 18 (56%) respondents indicated they would use metronidazole in addition to penicillin and gentamicin. Seven (22%) respondents indicated they would alter or select antimicrobials on the basis of results of susceptibility testing of cultured organisms when available. Other antimicrobials listed were TMS (3 respondents; 9%), enrofloxacin (2; 6%), and ceftiofur (1; 3%).

In adult horses with an abscess in the abdomen discovered at surgery, all 32 (100%) respondents indicated they would use antimicrobials. Eighteen (56%) indicated they would use potassium penicillin and gentamicin initially. Other antimicrobial drugs listed by the respondents on the basis of case description included metronidazole (10 respondents; 31%), TMS (4; 12%), rifampin (4; 12%), enrofloxacin (3; 9%), PPG (3; 9%), chloramphenicol (2; 6%), potassium penicillin alone (1; 3%), and erythromycin (1; 3%). Thirteen
(41%) respondents indicated they would alter their initial choice of antimicrobials on the basis of subsequent bacterial culture and susceptibility testing results. Respondents reported that duration of treatment of horses with an abdominal abscess was determined on the basis of indicators of resolution of the problem, including clinical and laboratory testing.

For adult horses with large colon impaction, 28 of the 32 (88%) respondents indicated they would use potassium penicillin and gentamicin for 1 to 5 days, with most indicating they would use them for 1 day. One (3%) respondent indicated he or she would use PPG alone, 1 (3%) indicated he or she would use PPG and gentamicin, and 1 (3%) indicated he or she would not use antimicrobials in this instance. For adult horses with small colon impaction, 27 of 32 (84%) respondents indicated they would use potassium penicillin and gentamicin for 1 to 10 days postoperatively, with most indicating they would use these drugs for 3 days. Seven (22%) respondents would use metronidazole in addition to potassium penicillin and gentamicin; PPG with gentamicin was reportedly used by 3 (9%) respondents. Three respondents indicated that duration of antimicrobial treatment in patients with small colon impaction depended on whether an enterotomy was performed; a longer duration of treatment was given in patients that had had an enterotomy performed.

For adult horses that developed a fever (rectal temperature, ≥ 38.9 C [102 F]) for > 2 days, 7 of 32 respondents indicated that whether to use or change antimicrobials would depend on factors other than just fever, such as results of laboratory testing or additional clinical findings and cause of the fever. Three respondents indicated they would perform bacterial culture and susceptibility testing if the site of infection could be defined and would base their antimicrobial choice on results of these tests. Eighteen (56%) respondents indicated they would use potassium penicillin and gentamicin for 2 to 7 days. Two (6%) respondents indicated they would use PPG with gentamicin. Six (19%) respondents indicated they would use metronidazole in addition to penicillin and gentamicin. Two (6%) respondents indicated they would use or switch to ceftiofur, and 1 (3%) indicated he or she would use drugs such as TMS or ampicillin with gentamicin.

In adult horses that had leukopenia (WBC count, < 5,000 cells/μL) during the perioperative period, 16 of the 32 (50%) respondents indicated they would use potassium penicillin and gentamicin for 1 to 5 days postoperatively, with most indicating they would use them for 3 days or until the WBC count returned to normal. Two (6%) respondents indicated they would use PPG and gentamicin. Eleven (34%) respondents indicated they would not use antimicrobials intravenously until 1 day after the drains were placed, horses were treated with potassium penicillin and gentamicin for 3 to 5 days, and 1 respondent indicated that if abdominal drains were placed, horses were treated with antimicrobial drugs until 1 day after the drains were removed. One respondent indicated choice of antimicrobial drugs was influenced by history of drug reactions, and 1 respondent indicated that he or she routinely treated neonatal foals with antimicrobials for 3 days longer than adults.

During the antimicrobial drug shortage, 18 of the 32 (56%) respondents chose to use ampicillin instead of potassium penicillin. Nine (28%) respondents used PPG, whereas 9 (28%) used ceftiofur instead of potassium penicillin. Other antimicrobial drugs listed included TMS (3 respondents; 9%), enrofloxacin (2; 6%), and cefazolin (1; 3%). These drugs were being used more often because of the antimicrobial drug shortage, but duration of use of these alternative drug choices generally did not change. Some respondents said that duration of use was dependent on the severity of the underlying condition.

Discussion

The present study represents 1 of the first efforts to document antimicrobial use in a segment of equine patients, that is, those undergoing surgery because of colic at a veterinary teaching hospital. The response rate (40%) was considered good by the authors and was likely enhanced because of the novel approach to administration of the questionnaire (ie, the Web-based format) and the ease with which the survey could be completed. Only estimates were requested for many of the questions, and although some respondents may have reviewed hospital medical records or surgery logs, this was not required. If, in an attempt to limit recall bias, we had required respondents to review records of all equine patients undergoing surgery, the response rate would likely have been lower. Answers for questions requesting estimates of number of procedures...
and occurrence of complications were grouped into broad categories, and we assume that this minimized the impact of recall bias. However, we do not have any validation of this assumption. Responses were obtained from > 1 respondent at 8 veterinary teaching hospitals, but no hospital was represented by > 3 respondents. Because of the breadth of the responses, it seems unlikely that the results could have been skewed by 1 veterinary teaching hospital's practices.

It is important to realize that the respondents to this survey represent only a portion of those veterinarians who perform surgery on equine patients with colic, and results only reflect the experiences and practices of these respondents. However, these individuals have an impact on antimicrobial use beyond their own patients, as they practice at veterinary teaching hospitals and, thus, are role models for their students, interns, and residents. They also provide information to veterinarians to whom they provide continuing education.

Results of this survey are the opinions of the respondents and not necessarily the recommendations of the authors. Several authors recommend the use of antimicrobial drugs in equine patients with colic that are undergoing surgery because of the potential for contamination with enteric flora during bowel decompensation, enterotomy, and bowel resection. It has also been emphasized by several authors that the likelihood that contamination will occur is not known prior to surgery in such patients and that antimicrobial drugs should, therefore, be administered prophylactically. Few respondents indicated that their hospitals had a policy regarding antimicrobial drug use in equine patients undergoing surgery because of colic, yet the type of antimicrobials used was fairly uniform among respondents. Results of the present study suggest that most equine patients undergoing surgery because of colic at veterinary teaching hospitals in the United States receive antimicrobial drugs that the drugs used are similar for the various hospitals that were represented, and that, for the most part, the drugs used were fairly uniform irrespective of the type of colic, whereas the duration of treatment varied with the type of colic and the surgical findings. The combination of potassium penicillin and gentamicin was the most commonly used treatment.

The need for long-term antimicrobial drug treatment in equine patients with colic is unknown. There appeared to be a broad range in duration of antimicrobial drug treatment intra- or postoperatively (from 1 dose to 5 days of treatment following uncomplicated colic surgery in adult horses) in the present study, with most respondents administering drugs for 1 day after surgery. Only 2 respondents indicated that they did not give any antimicrobial drugs intra- or postoperatively to adult equine patients with uncomplicated colic surgery. For adult horses requiring an enterotomy or bowel resection, all respondents used antimicrobial drugs for 1 to 10 days, with most using them for 3 days. These equine patients would seem to be the ones most likely to have bacterial contamination of the abdomen and surgical incision and, thus, the ones most likely to require antimicrobial treatment. However, to the authors' knowledge, there are no studies of the benefit of antimicrobial treatment in such cases. The respondents were not asked whether they were critically evaluating the need for long-term antimicrobial drug treatment in equine patients. Therefore, we were not able to determine whether the reported duration of treatment was determined on the basis of clinical experience, tradition, or other factors.

Most respondents to the survey used a combination of potassium penicillin and gentamicin for both preoperative and postoperative antimicrobial treatment of equine patients undergoing surgery because of colic. Together, penicillin and gentamicin would have activity against a broad range of gram-positive and gram-negative organisms. However, we did not ask respondents specifically why they chose the antimicrobial drugs that they used, and considerations such as cost, frequency of adverse effects, and tradition may have played as much a role as spectrum of action. There were slight variations, particularly for horses with peritonitis or an abdominal abscess; in these patients metronidazole was used more frequently, compared with all equine patients with colic.

During the recent antimicrobial shortage, most respondents indicated that they used ampicillin or PPG in place of potassium penicillin. Both PPG and potassium penicillin have been associated with complications, including allergic reactions. Procaine penicillin has also been associated with muscle soreness, whereas potassium penicillin has been associated with an increased risk of shedding Salmonella organisms in the feces.

Salmonellosis was the bacterial disease most commonly recognized by respondents as occurring at an above-average rate at their hospitals. Several factors have been reported to be predisposing factors for salmonellosis in equine patients, including gastrointestinal diseases such as colic, antimicrobial drug administration, alterations in diet, and stress such as shipping.

Infection with methicillin-resistant Staphylococcus spp was also commonly cited by respondents as occurring at an above-average frequency. Although predisposing factors in horses have not been identified, such infections are often nosocomial in human patients. Nosocomial Staphylococcus spp infection in horses hospitalized in veterinary teaching hospitals has been reported previously.

Approximately 50% of respondents to the present survey indicated that ≥ 11% of equine patients undergoing surgery because of colic developed diarrhea and incisional complications during the postoperative period, and approximately 25% of respondents indicated that ≥ 11% of these patients developed thrombophlebitis and catheter-site infections during the postoperative period. It would appear that we still have an opportunity to reduce the occurrence of these complications in equine patients.

References
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