

Surgery in a veterinary outpatient community medicine setting has a good outcome for dogs with pyometra

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OBJECTIVE

To compare the outcome of canine pyometra surgeries performed at referral hospitals with those performed at community clinics (outpatient settings), and to evaluate factors that impact outcome.

ANIMALS

133 client-owned dogs with pyometra treated with ovariohysterectomy (OHE) at 2 community clinics or 2 referral hospitals between July 1, 2017, and June 30, 2019.

PROCEDURES

A retrospective electronic medical record search was used to identify eligible cases. Data about patient demographics and clinical characteristics were collected and analyzed for factors that could have impacted outcome.

RESULTS

Eighty-three dogs were treated at referral hospitals; 50 dogs were treated at community clinics. Survival to hospital discharge for all dogs was 97% (129/133) and did not differ between treatment facility type. Dogs treated at both types of facilities were similar in age, body weight, and clinical signs. Median duration between diagnosis and OHE was significantly shorter for dogs treated at referral hospitals (0 day; range, 0 to 0.7 days) versus community clinics (1.0 day; range, 0 to 14.0 days); however, delay was not related to survival to hospital discharge. Duration of hospitalization did not impact survival to hospital discharge nor survival for at least 1 week after surgery.

CLINICAL RELEVANCE

Results indicated that OHE for pyometra in dogs has a good outcome and that, although prompt surgical treatment remains a goal, in cases where limitations to performing surgery exist, a delay until surgery or discharging patients the same day is still associated with a high degree of success.

Pyometra is a common disease of sexually intact female dogs^{1,2} and has been studied extensively as a model for sepsis and systemic inflammation.³⁻⁷ Ovariohysterectomy (OHE) is well established as the recommended treatment for all cases of pyometra except in the most valuable breeding dogs.^{1,2} The prognosis for pyometra treated by OHE is good, with mortality rates reported to be low, with deaths associated with sepsis or acute kidney injury.^{1,8} Complications such as peritonitis and ruptured uterus can occur^{1,8}; however, with prompt surgery, the prognosis is still thought to be good even when patients are systemically ill.^{1,3,4,6}

Despite the excellent prognosis for this disease, many dog owners are unable to afford the cost of emergency OHE for pyometra, which may lead to

euthanasia or death from untreated infection. It is well recognized that, for a variety of reasons, low-income pet owners are less likely to have dogs that are spayed.⁹ Pyometra is therefore common among pets with owners who struggle to access veterinary care as a result of finances or other barriers.^{10,11} Reported surgical costs for urgent or emergent treatment of pyometra in emergency and critical care practices, including the costs for hospitalization and surgical treatment, can exceed \$4,000.¹² In daytime primary care practices, the costs can often be only slightly less, although it varies somewhat with geographic location.¹² Pyometra may also be treated in an outpatient setting, such as may occur in a high-quality, high-volume spay-neuter (HQHVSN) clinic, although limited information exists regarding the

outcome of these cases, and, by the nature of HQH-VSN clinics, overnight care is not provided.¹²

Although OHE for pyometra can be performed in general practice, it is less common in many locations, likely because of the difficulty of adding an urgent surgical procedure in a busy hospital, because of a migration away from nonroutine soft tissue surgeries by practitioners, and because of the perception that pyometra patients need specialized care or that surgery for pyometra must be performed as soon as possible if the patient is to survive. The objectives of our study were to compare the outcome of pyometra surgeries performed at referral hospitals with those performed at community clinics (outpatient settings), and to evaluate whether the duration between diagnosis and surgery or provision of postoperative care influenced outcome. Specifically, in cases with financial resource limitations, after a diagnosis of pyometra, it may be several days to even weeks before surgical care can be negotiated at a subsidized rate. In addition, because the cost of supportive care in a 24-hour hospital adds to the cost of care, we wished to evaluate the impact of same-day discharge on outcome. Last, we wanted to examine whether having an inexperienced surgeon (trainee) affected outcome.

Methods

Case selection

All dogs with pyometra presented to any of 4 Cummings School of Veterinary Medicine teaching hospitals between July 1, 2017, and June 30, 2019, were eligible for enrollment. Medical records from the 4 Cummings hospitals that treat dogs and use a common electronic medical record (EMR) program (Veterinary Practice Management Software, University edition, StringSoft Inc) were reviewed, including the Foster Hospital for Small Animals (FHSA), Tufts Veterinary Emergency Treatment and Specialties (TVETS), Tufts at Tech Community Veterinary Clinic (TAT), and the Luke and Lily Lerner Spay Neuter Clinic (Lerner). The first 2 hospitals are 24-hour teaching and referral hospitals, and the second 2 are community medicine clinics with a focus on outpatient care. Based on an agreement among hospital leadership, dogs that were presented to the teaching and referral hospitals by owners who could not afford specialty-level surgery (estimated at \$3,500 to \$4,000), who did not have a primary veterinarian who could perform the surgery, and who did not qualify for a national veterinary medical credit service (Care Credit Veterinary Financing, Synchrony Bank) were eligible to have an OHE performed at Lerner by a supervised veterinary student or intern for a subsidized cost of \$200. Full-service veterinary care to qualified low-income pet owners is provided at TAT by supervised veterinary students. For the purposes of our study, TAT and Lerner were classified as community clinics, whereas TVETS and FHSA were classified as referral hospitals.

At the community clinics, surgeries were performed by supervised veterinary students or interns

on an outpatient basis. Surgeries in the referral hospital were performed by board-certified veterinary surgeons, surgery residents, or American College of Veterinary Emergency Critical Care diplomates who all had extensive surgical training. At the referral hospitals, individualized anesthesia protocols were administered by designated anesthesia nurses. Patients were treated with IV fluids before, during, and after surgery, and patients were hospitalized for at least 1 night after surgery. In community medicine, standardized HQH-VSN protocols¹³ were used and may or may not have been adjusted for sick patients. Some patients received IV fluid support at surgeon discretion; however, all patients were discharged as soon as they had recovered from anesthesia. In accordance with HQH-VSN guidelines,¹³ all patients at all clinics received perioperative pain medications. Antimicrobials (most typically cefazolin) were given according to each hospital's protocol. Data on antimicrobials were not collected from the EMRs.

Procedures

An initial list of potential cases was identified by performing a key word search of each hospital's medical records system with "pyometra" as the search term, and by limiting the search to dogs that were presented during the study period. Medical records were reviewed, and data were collected with the use of a standard data collection template (Excel Office 365, version 2005, Microsoft Corp). Demographic variables recorded were patient identification number, name, breed, body weight, and age (recorded as date of birth). Additional information collected for each dog included information about the surgery, including at what hospital the surgery was performed, whether the animal was originally referred to that hospital, and the date pyometra was originally diagnosed if different from the date of the surgery. Patient physical status information that was recorded included rectal temperature, heart rate, respiratory rate, body condition score, estimated percentage of dehydration, mentation (eg, alert, dull, obtunded), and whether the patient was ambulatory. In addition, information was collected about the dog's clinical signs prior to presentation (eg, vomiting or vulvar discharge) and any comorbidities—in particular, whether there was any indication of cardiac dysfunction (eg, the presence of a murmur) or whether the dog also had a mammary tumor. Laboratory values were recorded, if determined, along with the results of any diagnostic imaging. The date of surgery, date of hospital discharge, and date of diagnosis were used to calculate the number of days between diagnosis and surgery as well as the number of days spent in the hospital after surgery. The primary measurement of survival was survival to hospital discharge. For dogs that did not survive to hospital discharge (nonsurvivors), the date of death was used to determine survival time. For dogs that died after hospital discharge, we relied on the owner reporting the date of death to the hospital. Records were reviewed to determine whether dogs that were discharged from the hospital alive (survivors) were

alive beyond 1 week after surgery; however, this information was not available for all dogs.

Statistical analysis

Statistical software (SPSS Statistics, version 22.0, IBM Corp) was used for analysis. Descriptive statistics were calculated for numeric variables, and frequencies for categorical ones. When testing for differences in numeric data between 2 groups, the Mann-Whitney test was used because the data were not distributed normally. Associations between categorical variables and type of hospital (community clinic vs referral hospital) were assessed with the Pearson χ^2 test or the Fisher exact test. Values of $P < 0.05$ were considered significant.

Results

A total of 133 dogs were identified for inclusion during the study period. The dogs had a median body weight of 22.2 kg and a median age of 8.0 years (**Table 1**). There were no significant differences in body weight or age of dogs on the basis of hospital type (community clinics vs referral hospital) where treatment occurred. Dogs were reported as mixed-breed dogs ($n = 23$), pit bull-type dogs (23), Chihuahuas (11), Golden Retrievers (10), Labrador Retrievers (10), Yorkshire Terriers (7), Shih Tzu (4), German Shepherd Dogs (3), Miniature Schnauzers (3), Pugs (3), American Bulldogs (2), Beagles (2), Boerboels (2), Belgian Malinois (2), Havanese (2), Maltese (2), Rottweilers (2), Siberian Huskies (2), Saint Bernards (2), and 1 each of a Brittany, American Eskimo Dog, Bearded Collie, Cocker Spaniel, Great Dane, Mastiff, Norwegian Elkhound, Cavalier King Charles Spaniel, Irish Wolfhound, Collie, Shetland Sheepdog, Bichon Fries, Doberman Pincher, Newfoundland, Poodle, Basset Hound, Rhodesian Ridgeback, and English Bulldog. In addition, the breed or type was not listed for 1 dog. Chihuahuas

and mixed-breed dogs, including pit bull-type dogs were most commonly reported across all participating hospitals.

Hospital type

More dogs with pyometra were presented to the referral hospitals ($n = 83$) than to community clinics (50). Of the 83 dogs presented to the referral hospitals, 30 had surgery at TVETS and 53 had surgery at FHSA. Of the 50 dogs that had surgery at a community clinic, 25 had originally been presented to one of the participating referral hospitals, and the remaining 25 were either patients of the community clinic or were referred directly by their primary veterinarian. Among the dogs that had surgery at a community clinic, 38 had surgery at Lerner and 12 had surgery at TAT.

Outcome

Of the 133 dogs that had surgery for pyometra, 4 did not survive to hospital discharge, resulting in an overall survival rate to hospital discharge of 97.0% (95% CI, 92.5% to 98.8%). All 4 dogs that did not survive to discharge had surgery at a referral hospital (2 at TVETS and 2 at FHSA). Of the 129 dogs that survived to hospital discharge, 4 dogs died within 1 week after discharge—2 dogs treated at community clinics and 2 dogs treated at referral hospitals—yielding an overall survival rate at 1 week after surgery of 94.0% (95% CI, 88.6% to 96.9%). There was no association between hospital type and survival to hospital discharge (Fisher exact test, $P = 0.30$) or not surviving for at least 1 week after surgery (Fisher exact test, $P = 0.71$).

Comparison of clinical signs for dogs grouped by treatment facility

In terms of clinical signs, there were no significant associations between the occurrence of vomiting ($\chi^2 = 0.46$, $P = 0.50$), vulvar discharge ($\chi^2 = 1.27$, $P = 0.26$), tachycardia ($\chi^2 = 1.75$, $P = 0.19$), or rectal

Table 1—Results of the Mann-Whitney U test to identify potential differences in continuous variables of interest for 133 client-owned dogs with pyometra that were presented for ovariohysterectomy between July 1, 2017, and June 30, 2019, grouped on the basis of whether dogs were treated at a community clinic ($n = 50$) versus a referral hospital ($n = 83$).

Variable	Total			Community clinic			Referral hospital			U statistic	P value
	No. of dogs	Median (range)	IQR	No. of dogs	Median (range)	IQR	No. of dogs	Median (range)	IQR		
Age (y)	133	8.0 (1.0–15.0)	6.0–10.0	50	8.0 (1.0–14.0)	5.0–10.0	83	8.0 (2.0–15.0)	7.0–10.0	2,309.0	0.27
Body weight (kg)	132	22.2 (1.2–69.0)	6.3–32.2	49	19.8 (1.7–41.3)	6.3–26.8	83	23.6 (1.2–69.0)	6.4–35.0	2,367.5	0.12
Heart rate (beats/min)	122	132.0 (60.0–220.0)	120.0–156.0	48	132.0 (80.0–220.0)	120.0–158.0	74	134.0 (60.0–190.0)	120.0–156.0	1,715.0	0.75
Respiration rate (breaths/min)	86	32.0 (14.0–60.0)	24.0–36.0	32	28.0 (18.0–60.0)	24.0–36.0	54	32.0 (14.0–60.0)	28.0–36.0	1,095.0	0.04
Creatinine concentration (mg/dL)	91	0.8 (0.4–4.9)	0.7–1.0	23	0.8 (0.5–4.9)	0.7–1.0	68	0.8 (0.4–4.8)	0.7–1.0	789.5	0.95
Duration between diagnosis and surgery (d)	129	0 (0–14.0)	0–1.0	49	1.0 (0–14.0)	0–1.0	80	0 (0–7.0)	0–1.0	1,242.0	<0.01
Duration of postsurgical hospitalization (d)	115	1.0 (0–3.0)	0–1.0	48	0 (0–2.0)	0–0	67	1.0 (0–3.0)	1.0–2.0	3,042.5	<0.01

IQR = interquartile (25th to 75th percentile) range.

Table 2—Overall findings and results of Pearson's χ^2 test or Fisher's exact test (when expected cell counts are < 5) for the dogs described in Table 1, grouped on the basis of whether dogs were treated at a community clinic ($n = 50$) versus a referral hospital ($n = 83$).

Clinical signs	Total		Community clinic		Referral hospital		χ^2 Statistic	P value
	No. of dogs with status known	No. (%) of affected dogs	No. of dogs with status known	No. (%) of affected dogs	No. of dogs with status known	No. (%) of affected dogs		
Vomiting	114	37 (33)	42	12 (29)	72	25 (35)	0.46	0.50
Vulvar discharge	120	89 (74)	49	39 (80)	71	50 (70)	1.27	0.26
Tachycardia	123	73 (59)	48	32 (67)	75	41 (55)	1.75	0.19
Rectal temperature outside of reference limits	120	51 (43)	47	17 (36)	73	34 (47)	1.27	0.26
Mentation	—	—	—	—	—	—	—	0.31 ^a
BAR	132	57 (43)	49	26 (53)	83	31 (37)	—	—
QAR	132	55 (42)	49	17 (35)	83	38 (46)	—	—
Dull	132	19 (14)	49	6 (12)	83	13 (16)	—	—
Nonresponsive	132	1 (0)	49	0 (0)	83	1 (1)	—	—
Ambulatory	130	118 (91)	49	44 (90)	81	74 (91)	—	0.76 ^a
Cardiac dysfunction	121	10 (8)	50	1 (2)	71	9 (13)	—	0.05 ^b

BAR = bright, alert, and responsive; QAR = quiet, alert, and responsive.

^aDetermined with the Fisher exact test.

^b $P = 0.045$.

temperature outside of reference limits ($\chi^2 = 1.27$, $P = 0.26$) for dogs treated at community clinics versus referral hospitals (Table 2). There was no significant association either in terms of signs of mentation (Fisher exact test, $P = 0.31$) or ambulatory status (Fisher exact test, $P = 0.76$) and hospital type. There was no significant difference in creatinine concentration between dogs presented to either hospital type ($U = 789.5$, $P = 0.95$). The proportion of dogs with concurrent cardiac dysfunction was significantly greater (Fisher exact test, $P = 0.045$) for those presented to the referral hospitals (9/71 [13%]) versus community clinics (1/50 [2%]).

Factors that could have affected patient outcome

In terms of case management factors, the median duration between diagnosis and definitive surgery was significantly shorter ($U = 1,242.0$; $P < 0.001$) for dogs treated at referral hospitals (0 day; range, 0 to 0.7 days) versus community clinics (1.0 day; range, 0 to 14.0 days; Table 1); however, this delay was not related to survival to hospital discharge ($U = 142.0$, $P = 0.10$) or survival to 1 week after surgery ($U = 518.0$, $P = 0.71$). The number of days a dog was hospitalized was not associated with survival to hospital discharge ($U = 103.0$, $P = 0.14$) or survival to 1 week after surgery ($U = 316.5$, $P = 0.54$).

In terms of individual patient factors, the proportion of dogs that did not survive to hospital discharge was significantly greater (Fisher exact test, $P = 0.04$) for dogs that were nonambulatory (2/12 [16.7%]) versus ambulatory (2/118 [1.7%]). Similarly, the proportion of dogs that did not survive to 1 week after surgery was significantly greater (Fisher exact test, $P = 0.03$) for dogs that were nonambulatory (3/12 [25.0%]) versus ambulatory (5/118 [4.2%]) at presentation. The proportion of dogs that did not survive to hospital discharge was significantly greater (Fisher exact test, $P = 0.03$) for those that

were unresponsive (1/1 [100%]) versus responsive (3/131 [2.3%]) at presentation. Neither tachycardia nor rectal temperature outside of reference limits was associated with survival to hospital discharge (Fisher exact test, $P \geq 0.99$) or survival 1 week after surgery (Fisher exact test, $P = 0.47$ and 0.72 , respectively). Similarly, creatinine concentration was not associated with survival to hospital discharge ($U = 152.0$, $P = 0.67$) or survival to 1 week after surgery ($U = 438.5$, $P = 0.13$). As mentioned earlier, more dogs treated at referral hospitals, compared with community clinics, had concurrent cardiac dysfunction (at least a murmur), although no dogs were in heart failure. There was no impact of heart disease on survival to hospital discharge (Fisher exact test, $P = 0.23$) or survival to 1 week after surgery (Fisher exact test, $P = 0.46$).

Discussion

Our study confirmed a high survival rate (97% [129/133]) among the population of dogs with surgically treated pyometra. This survival rate was remarkably similar to previous studies,^{8,14} despite the fact that our study was conducted at a veterinary teaching center. This high rate of survival was also seen in dogs that were operated on by less-experienced clinicians, were treated as outpatients, and potentially had treatment delays until surgery could be performed.

There was also no overall difference in survival rates between type of treatment facility (referral hospital vs community clinic), even though surgical experience and postoperative case management were very different between them. At the referral hospitals (compared with the community clinics), dogs waited less time between diagnosis and surgery, stayed in the hospital longer (up to 3 days), and underwent surgery performed by individuals with more advanced training in surgery.

In general, dogs that were presented to the referral hospitals and the community clinics were very similar. In fact, 25 of the 50 dogs that were presented to the community clinics had first been seen at one of the referral hospitals and were sent to the community clinic because of a lack of financial resources on the part of the owner. The fact that surgeries at the community clinics were performed by trainees and that most had good outcomes is important and aligns with previous evaluations of student training programs.¹⁵ In many cases, pet owners with financial constraints may be forced to consider euthanasia if they cannot afford treatment in an emergent setting. Although veterinarians may often have the belief that offering some care is better than euthanasia, studies that demonstrate good outcomes with basic, nonspecialized treatment provide support for this approach.

There was some indication that animals treated at the referral hospitals may have been sicker. For example, they had more concurrent heart disease (loosely defined as having a murmur or any other indication of cardiac disease); but, overall, they did not differ in terms of clinical signs and we do not believe the high survival rates among dogs treated at the community clinics was because the animals were not as sick, particularly because many of these dogs had a delay until surgery could be performed. Moreover, the presence of heart disease was not associated with decreased survival in our study.

As in a previous study,⁸ dogs that were not ambulatory or were unresponsive at the time of presentation were less likely to survive. However, injury severity scores were not routinely calculated and could not be calculated retrospectively because of a lack of biochemical data or CBCs. Severe leukopenia has been documented previously⁸ to be a negative prognostic indicator. Few dogs in either hospital category had a blood pressure measured prior to surgery, because it was not a routine parameter measured in dogs that appeared stable.

In our study, there was no difference in survival for dogs that experienced a delay prior to surgery. However, the total number of nonsurvivors was low, so this result should be interpreted with caution. If more practices, such as HGHVSN clinics and general practices, offer pyometra surgeries routinely, the amount of time delay experienced by owners searching for an affordable surgery option could be reduced. The overall results of our study suggest that the outcome of surgery would likely still be good, even if surgery has to be delayed. It has to be acknowledged that our results represent the 2 extreme ends of the care spectrum: either dogs that had full-service specialty care in a referral hospital or dogs that had outpatient surgery in an HGHVSN-style community clinic. Although the outcomes were similar in both settings, it may be that there is a reasonable middle ground, which we would describe as a surgery at a full-service practice with supportive care as indicated by the patient's condition, but one that aims to minimize the cost and length of hospitalization. In addition, our results

suggest that partnerships between general practice and HGHVSN clinics have the potential to provide an additional option for owners, with the anticipation of a good outcome.

Our study had several important limitations. First, the overall number of nonsurvivors was low, as was the total sample size. A post hoc power analysis suggested that 292 cases would have been necessary to detect small effect sizes of 0.1 at 80% power, suggesting that, although some analyses with larger effect sizes may have been adequately powered, others with small effect sizes, such as survival rates, were not. In addition, as several management strategies were predetermined by hospital type, it may be difficult to generalize our results to all community clinic settings. Our study was retrospective, and some data values were missing from the EMRs. In addition, our study only included dogs owned by individuals able to bring them to one of the participating facilities, and these dogs could be different from other populations of dogs. For example, owners may have chosen to euthanize their animal when it was evaluated elsewhere; they may not have known of the existence of a low-cost treatment option. Also, the medical records search only captured animals that had surgery for pyometra, but not dogs for which owners elected euthanasia prior to surgery. Another limitation was that we did not collect data from the EMRs about perioperative antimicrobial administration. Although it was standard practice at all 4 participating treatment facilities to administer cefazolin perioperatively and we do not believe the antimicrobials used were likely to have affected outcomes, we could not draw any conclusions about the impact of antimicrobials on our patient population.

Regarding longer-term survival, we could not say for certain how long the 125 dogs that survived to 1 week after surgery went on to live; we only know that we had no report of any of them dying within 1 week after surgery. Although we examined the EMRs for future visits or contact with the owners, some dogs were lost to follow-up; thus, we could not conclude with certainty that no other dogs died after leaving the hospital than the 4 we report here. Information indicating the dogs were alive beyond 1 week after surgery was only available for about half the dogs. However, in our experience, owners whose dogs have complications or die soon after surgery generally call us spontaneously to report that outcome, even in the spay-neuter setting. Thus, we suspect the number of dogs that died shortly after surgery not included in our counts was low to none.

In conclusion, pyometra treated surgically has a good outcome, whether at a specialty referral hospital or in a community clinic setting. Although prompt surgical treatment for pyometra remains a goal, the findings of our study indicate that even when surgery was delayed, the delay did not lead to worse outcomes. We believe it is likely that dogs with pyometra that are presented in stable condition after hours can wait until the next day for surgery, and that this approach is a reasonable and likely effective strategy to reduce the cost of care. In addition, our findings

indicate that discharging patients the same day as the OHE procedure for pyometra was still associated with a high degree of success. Partnership with HQHVSN clinics may be a useful model to increase access to surgical treatment for pyometra, and outpatient treatment can be successful in most cases.

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