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## Reproductive emergencies in the bitch: a retrospective study

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**ABSTRACT.** This study aimed at analyzing reproductive emergencies (RE) in bitches brought in to a general veterinary hospital during a 24 month-period; evaluating their clinical-epidemiological features; and assessing the results of applied therapy. RE accounted for 11.8% of all female dog emergency clinical cases. Pyometra and dystocia accounted for 56.0% and 32% of the RE, with three (Newfoundland, Siberian Husky, Chow-Chow) and nine breeds (Boston Terrier, French Bulldog, Bernese Mountain Dog, Yorkshire Terrier, St. Bernard, Maltese, Chihuahua, Doberman and Boxer) found at higher risk of pyometra and dystocia, respectively. Fifty-four (96.4%) cases of pyometra were surgically managed, with a mortality of 13.0%. Primary uterine inertia (19 cases) was the main cause (59.4%) of dystocia. Medical treatment was attempted in 23 cases of dystocia (71.9%) but found to be effective in only two of them, leading to a high percentage of caesarian sections (30/32 cases, 93.8%). Both pyometra and dystocia had a high percentage of success following surgery. The use of standardized diagnostic and treatment protocols for the approach of RE allowed favorable outcomes.

**Keywords:** bitch, dystocia, emergencies, pyometra, reproductive

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## INTRODUCTION

Although canine reproductive emergencies are common, studies evaluating incidence and treatment outcomes are scarce. Pyometra and dystocia have been reported to be the most frequent reproductive emergencies in bitches, followed by hypocalcemia, metritis, mastitis, uterine torsion and uterine prolapse (Biddle and Macintire, 2000; Jutkowitz, 2005).

Clinical signs of pyometra include vaginal discharge, anorexia, lethargy, vomiting, polyuria and polydipsia. Dehydration, toxemia, decompensated septic shock and death may occur. Severity of clinical signs is related to the deleterious effects of present bacterial endotoxins, on whether the cervix is "open" sufficiently to allow drainage of the uterine purulent fluid, and owner response to noting dog being ill (Jutkowitz, 2005; Kustritz, 2005; Pretzer, 2008a; Verstegen et al., 2008; Crane, 2009). Radiography and ultrasound imaging are valuable tools to aid in confirming diagnosis (Kustritz, 2010). Treatment of pyometra can be attempted medically, but ovariohysterectomy (OVH) is considered the best option (Kustritz, 2010). Surgical removal of the infected uterus allows for more rapid elimination of bacterial endotoxins (Kustritz, 2010) and prevents recurrence (Verstegen et al., 2008). In addition, medical treatment of pyometra typically involves the use of prostaglandins, dopamine agonists and/or progesterone receptor antagonists (Verstegen et al., 2008; Crane, 2009).

Primary uterine inertia is the most common cause of dystocia in bitches, followed by abnormal fetal presentation and posture (Jutkowitz, 2005; Linde-Forsberg, 2005; Smith-Carr, 2005; Kutzler, 2009). Dystocia rates in bitches have been reported to be around 5%, with some breeds such as the Bulldog, Boston Terrier, Scottish Terrier (Jutkowitz, 2005; Linde-Forsberg, 2005), Chihuahua, Yorkshire Terrier (Kustritz, 2010), Cocker Spaniel, Teckel and Welsh Corgi (Kutzler, 2009) being regarded as predisposed. Radiographic examination of the abdomen allows determination of fetal number, size, location, position, and may be useful in determining viability

(Jutkowitz, 2005; Linde-Forsberg, 2005; Smith-Carr, 2005; Kutzler, 2009). However, abdominal ultrasound examination is the preferred tool for assessing fetal viability and stress (Jutkowitz, 2005). It has been suggested that 60 to 80% of bitches with dystocia will require cesarean section (Jutkowitz, 2005). Prior to recommending cesarean section, medical management of dystocia can be attempted using ecbolic agents, when obstructive causes are excluded (Jutkowitz, 2005; Linde-Forsberg, 2005; Pretzer, 2008b; Kutzler, 2009; Wiebe, 2009). However, the success rate of medical management of dystocia has been reported to be poor, ranging between 20 and 40% (Jutkowitz, 2005).

The purposes of this study were to: a) quantify the reproductive emergencies diagnosed in bitches brought to a multi-doctor, 24-hour-a-day, urban general veterinary hospital; b) analyze available epidemiological data and clinical features associated with each condition; and c) acquire information on different treatments outcomes.

## MATERIALS AND METHODS

### Inclusion criteria

Medical records stored in the Winvet® Program/Software V12.R5.M4 2.0 of all emergency cases involving bitches (n = 850) admitted at Montenegro Veterinary Hospital, located in the Greater Oporto area, Portugal, in a 24-month period were analyzed. All the reproductive emergencies from those records (n = 100; 11.8%) were collected and studied (Table 1).

The remaining emergency cases in bitches were related with gastroenterology (~25%), orthopaedics and neurology (~20%), respiratory system (~15%), urinary/renal system (~10%), surgical dermatology (~10%) and other conditions (~10%). Pyometra, dystocia, mastitis, metritis, postpartum hypocalcemia, uterine rupture, vaginal and uterine prolapse, uterine hemorrhage, stump pyometra were included among the reproductive emergencies. Frequency, breed distribution for each disorder, applied diagnostic protocols, as well as clinical evaluation and complementary exams, treatment protocols and their success rates were analyzed.

### Clinical approach and general procedures

A thorough anamnesis was performed for every animal admitted to the hospital. A thorough physical examination was performed on each day. Gynecological examination included assessment of vaginal mucosa and then evaluation of the vaginal lumen for polyps, masses, fetuses, strictures and discharges. The need for complementary studies was determined for each dog after clinical and gynecological examinations. Complementary testing included complete blood count (CBC), serum biochemical profile, urinalysis, vaginal cytology, abdominal ultrasound scanning and/or radiographs. Clinical protocols used to address pyometra and dystocia, the two most common reproductive emergencies, were as follows:

### Pyometra

After a presumptive diagnostic of pyometra, the minimum data base studies performed were: CBC, blood urea nitrogen (BUN) and creatinine (all carried out in 39 dogs), measurements of total protein, glucose, alanine aminotransferase (ALT) and alkaline phosphatase (ALP) (both carried out in 36 and 29 dogs, respectively) and ultrasonographic evaluation of the uterus and its contents.

Priority was given to rapidly stabilizing each dog prior to surgery or medical treatment through the use of intravenous fluid therapy adjusted to meet the electrolytic and acid-base needs of the dog. Antibiotics (metronidazole, ampicillin and enrofloxacin) and specific treatments were used as needed (e.g. metoclo-

**Table 1.** Distribution and frequency of reproductive emergencies (total, pyometra, dystocia and other) by breed in 850 bitches admitted at a general veterinary hospital as emergency cases.

Breed	No. of bitches	Relative distribution (%)	No. of total RE cases (%)	No. of pyometra cases (%)	No. of dystocia cases (%)	No. of other RE cases (%) <sup>1</sup>
Crossbred	273	32.1	17 (6.2)	15 (5.5)	1 (0.4)	1 (0.4)
Boxer	62	7.3	8 (12.9)	2 (3.2)	4 (6.5)	2 (3.2)
Labrador Retriever	52	6.1	7 (13.5)	4 (7.7)	1 (1.9)	2 (3.8)
Poodle	52	6.1	3 (5.8)	3 (5.8)	0 (0.0)	0 (0.0)
Rottweiler	28	3.3	3 (10.7)	2 (7.1)	1 (3.6)	0 (0.0)
German Shepherd	28	3.3	2 (7.1)	1 (3.6)	0 (0.0)	1 (3.6)
Pinscher	27	3.2	2 (7.4)	0 (0.0)	1 (3.7)	1 (3.7)
Yorkshire Terrier	22	2.6	7 (31.8)	0 (0.0)	6 (27.3)	1 (4.5)
Siberian Husky	20	2.4	6 (30.0)	6 (30.0)	0 (0.0)	0 (0.0)
St. Bernard	19	2.2	8 (42.1)	3 (15.8)	5 (26.3)	0 (0.0)
Doberman	18	2.1	5 (27.8)	3 (16.7)	2 (11.1)	0 (0.0)
Great Dane	13	1.5	2 (15.4)	2 (15.4)	0 (0.0)	0 (0.0)
Chow Chow	7	0.8	2 (28.6)	2 (28.6)	0 (0.0)	0 (0.0)
Bernese Mountain Dog	5	0.6	3 (60.0)	0 (0.0)	2 (40.0)	1 (20.0)
French Bulldog	4	0.5	4 (100)	1 (25.0)	2 (50.0)	1 (25.0)
Newfoundland	5	0.6	2 (40.0)	2 (40.0)	0 (0.0)	0 (0.0)
Boston Terrier	4	0.5	3 (75.0)	0 (0.0)	2 (50.0)	1 (25.0)
Other with RE <sup>2</sup>	131	15.4	16 (12.2)	10 (7.6)	5 (3.8)	1 (0.8)
Other without RE <sup>3</sup>	80	9.4	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	850	100	100 (11.8)	56 (6.6)	32 (3.8)	12 (1.4)

RE: reproductive emergencies;

<sup>1</sup>Type of other RE (no. of cases): hypocalcemia (2; crossbred & Pinscher), mastitis (3; Boxer, Labrador Retriever & Teckel), metritis (2; Bernese Mountain dog & Labrador Retriever), stump pyometra (1; Yorkshire Terrier), uterine hemorrhage (1; Boxer), uterine prolapse (1; French Bulldog), uterine rupture (1; Boston Terrier) or vaginal prolapse (1; German Shepherd Dog).

<sup>2</sup>Other breeds (n = 16) with a single case of RE (type; relative frequency), by alphabetic order: Argentinian Dogo (1 pyometra; 100%), Basset Hound (1 pyometra; 11.1%), Chihuahua (1 dystocia; 20.0%), Cocker Spaniel (1 dystocia; 2.7%), Dalmatian (1 pyometra; 8.3%), Entlebucher Mountain Dog (1 dystocia; 100%), German Shorthaired Pointer (1 pyometra; 33.3%), Golden Retriever (1 pyometra; 20.0%), Komondor (1 dystocia; 100%), Maltese (1 dystocia; 25.0%), Pekingese (1 pyometra; 6.7%), Portuguese Pointer (1 pyometra; 12.5%), Samoyed (1 pyometra; 10.0%), Shar Pei (1 pyometra; 20.0%), Shih Tzu (1 pyometra; 11.1%) and Teckel (1 other RE; 16.7%);

<sup>3</sup>Other breeds (n = 31) without RE (no. of bitches): Alentejo Mastiff (3), American Cocker Spaniel (1), Azores Cattle Dog (1), Belgian Shepherd (4), Boerboel (1), Brittany (5), Bullmastiff (1), Cane Corso (1), Collie (7), Dog of Castro Laboreiro (1), English Bulldog (4), Estrela Mountain Dog (14), Fox Terrier (1), Giant Schnauzer (3), Great Pyrenees (4), Ibizian Hound (1), Irish Setter (1), Pitbull (7), Pointer (3), Pomeranian (3), Portuguese Water Dog (1), Pug (1), Setter Gordon (1), Spanish Greyhound (1), Spitz (1), Transmontano Mastiff (1), Weimarener (1), Welsh Springer Spaniel (1), Welsh Terrier (1), West Highland White Terrier (4) and Whippet (1).

pramide for vomiting). The treatment of choice was OVH. Medical treatment was usually reserved for young pure-bred bitches (< 5 years of age, arbitrarily) intended to be used for reproduction, that were in general good health and with open-cervix pyometra. Medical treatment consisted of subcutaneous (SC) administration of 10 mg/kg of aglepristone (Alizin<sup>®</sup>, Virbac, France) at days 0, 1, 8 and 15 associated with 1 µg/kg of cloprostenol SC (Estrumate<sup>®</sup>, Intervet Schering-Plough, Portugal) at days 3, 5 and 7 (Gobello et al., 2003), followed by broad-spectrum antibiotic administration. The bitches were monitored three times a day for clinical response; body temperature, appetite, and vulvar discharge. Complete blood count and uterine ultrasonographies were carried out during and after treatment. Medical treatment was continued until the uterus returned to a normal size (uterine lumen < 10 mm) and a decrease in white blood cell (WBC) count was observed.

A pyometra was considered to have been treated with success when the bitch was clinically healthy 30 days after medical or surgical intervention.

### Dystocia

The diagnostic protocol for bitches with dystocia included: a) clinical evaluation of the bitch (general physical examination, thoracic auscultation, abdominal palpation, digital examination of vestibule and vagina to assess relaxation and patency of the birth canal; the existence of soft or bony obstruction or presence of fetuses; b) assessment of fetal viability through an ultrasound examination (less than 180 bpm was regarded as a sign of fetal distress) (Jutkowitz, 2005); and c) evaluation of fetal presentation and posture, as well as pelvic canal structure through abdominal radiographs. Whenever there was uncertainty about gestation length, serum progesterone (P<sub>4</sub>) concentration was estimated through a qualitative test (Ovulation test<sup>®</sup>, CPH Pharma<sup>®</sup>, Portugal), to avoid stimulation of parturition or recommendation of cesarean section with premature fetuses. Considering that a P<sub>4</sub> concentration below 1-2 ng/ml is required for parturition to occur (Johnston et al., 2001), cesarean sections were only performed when

the serum progesterone concentration was less than 1 ng/ml. Digital examination with a sterile well-lubricated glove was performed to assess for the degree of dilatation and vagina muscular tone (Linde-Forsberg, 2010), fetal position, and the presence of any vaginal anomaly. If a fetus could be palpated, presentation and viability were assessed. In addition, gentle feathering of the dorsal vaginal wall was also done to stimulate reflex contractions (Ferguson reflex). If a fetus was lodged within the birth canal, digital manipulation was attempted.

Causes of dystocia were classified as of maternal origin (primary uterine inertia, narrow birth canal, uterine torsion, and secondary uterine inertia) and of fetal origin (increased fetal size, fetal death or abnormal presentation and posture) or due to a combination of both (Table 5), as defined by Linde-Forsberg (2010). Primary uterine inertia was defined as the failure to begin and/or complete expulsion of normal-sized fetuses through a normal birth canal (Linde-Forsberg, 2010). Secondary uterine inertia was defined as occurring subsequent to prolonged uterine contractions that failed to expel a fetus obstructing the birth canal (due to fetal oversize, monstrosities or postural defects), failure to expel all pups in a large litter; or after obstruction of the birth canal because of a narrow pelvis (Johnston et al., 2001; Jutkowitz, 2005; Linde-Forsberg, 2010).

Medical treatment of dystocia was selected when the bitch was in a stable condition, the pups appeared viable and not distressed on ultrasonographic examination, the birth canal was dilated and there was compatibility between fetal size and the birth canal. Medical treatment consisted of one injection of 0.5-2.0 IU of oxytocin (IM) (Facilpart<sup>®</sup>, Syva, Spain). If no pup was delivered within 30 minutes, slow intravenous (IV) administration (0.2 ml/kg) of 10% calcium gluconate (Johnston et al., 2001) was administered in addition to a second dose of oxytocin (IM). If no pup was born within 30 minutes of the second oxytocin administration, a cesarean section was performed. Cesarean section was also the first treatment choice in case of feto-maternal obstruction, maternal fatigue or fetal distress (bpm < 180). For cesarean

**Table 2.** Numbers of total reproductive emergencies, pyometra and dystocia cases in bitches by age group.

Age group (years)	No. of RE cases	No. of pyometra cases (%) <sup>1</sup>	No. of dystocia cases (%) <sup>1</sup>
<2	2	0 (0.0)	1 (50.0)
2-3	22	4 (18.2) <sup>2</sup>	14 (63.6) <sup>2</sup>
4-5	20	7 (35.0)	11 (55.0)
6-7	16	12 (75.0) <sup>3</sup>	3 (18.8) <sup>3</sup>
8-9	13	9 (69.2) <sup>4</sup>	3 (23.1) <sup>4</sup>
≥10	27	24 (88.9) <sup>5</sup>	0 (0.0) <sup>5</sup>

RE: reproductive emergencies; <sup>1</sup>Percentagens are relative to the no. of RE cases for the same age group; <sup>2</sup> $p = 0.002$ ; <sup>3</sup> $p = 0.001$ ; <sup>4</sup> $p = 0.018$ ; <sup>5</sup> $p < 0.001$  (only significant differences are shown).

section, each bitch received intravenous fluid therapy, pre-anesthetic oxygenation, anesthetic induction with propofol (*ad effectum* to a maximum dose of 4 mg/kg) and anesthesia was maintained with oxygen and isoflurane. After the pups were extracted, 0.03 mg/kg of butorphanol (IV) and 0.2 mg/kg of meloxicam (SC) were administered. The cesarean sections were performed with an incision of the uterine body or the uterine horns. When OVHs were performed, the procedure was carried out after cesarean section and delivery of the litter.

Dystocia was considered successfully managed when both bitch and newborn puppies were alive 24 hours after delivery. The number of newborns euthanized due to malformation immediately after birth, the number of healthy pups 2 months after delivery, the occurrence of maternal complications up to one month after delivery was recorded. The number of females neutered after the cesarean section was also noted.

### Statistical analysis

Descriptive results are presented as average  $\pm$  standard deviation (SD). The chi-square test was used to compare percentages of pyometra and dystocia among the same age groups. Additionally, univariate logistic regression analysis identified breeds as independent risk factors for pyometra, dystocia and other reproductive emergencies, by calculating odds ratios (OR) and their 95% confidence intervals (CI).

Crossbred bitches composed the reference group (OR = 1.0). Analyses were carried out using SPSS 11.5 software for Windows, with a probability ( $p$ ) value  $< 0.05$  regarded as statistically significant (Petrie and Watson, 2006).

## RESULTS

### Reproductive emergencies: type and percentages

Reproductive emergencies accounted for 100 (11.8%) of the 850 female dogs admitted as emergencies to the hospital during the 24-month period (Table 1). Only two disorders had a sizeable number of cases: pyometra with 6.6% ( $n = 56$ , accounting for 56.0% of the reproductive emergency cases) and dystocia with 3.8% ( $n = 32$ , 32.0% of the reproductive emergency cases) of the total cases. Twelve dogs presented other reproductive emergencies like hypocalcemia, mastitis, metritis, stump pyometra, uterine hemorrhage, uterine prolapse, uterine rupture and vaginal prolapse. Distribution by breed is summarized in Table 1. The comparison of pyometra and dystocia percentages among the same age groups showed significant differences at 2-3, 6-7, 8-9 and  $\geq 10$  years old (Table 2).

### Pyometra

The Chow-Chow, Siberian Husky and Newfoundland had significantly increased risk of pyometra, with OR of 6.9, 7.4 and 11.5, respectively (Table 3).

There were laboratory data from 39 of the 56

**Table 3.** Breed as a risk factor for pyometra in bitches.

Breed	Pyometra (%)	OR	95% CI	<i>p</i> value <sup>1</sup>
Crossbred	5.5	Ref	–	–
Chow Chow	28.6	6.9	1.2-38.4	0.028
Siberian Husky	30.0	7.4	2.5-21.9	< 0.001
Newfoundland	40.0	11.5	1.8-73.9	0.010

OR: Odds ratio; CI: confidence interval; Ref: reference (OR = 1.0); <sup>1</sup>Only statistically significant differences are shown.

bitches with pyometra. Among these, 13 (33.0%) had normocytic normochromic anemia (hematocrit [average  $\pm$  SD] = 30.8  $\pm$  4.8%). White blood cell counts, available for 35 bitches, demonstrated that 28 (80.0%) had leukocytosis (average  $\pm$  SD = 36.2  $\pm$  15.6  $\times$  10<sup>3</sup> cells/l), while 7 (20.0%) had a normal count.

BUN and creatinine was measured in 39 bitches with pyometra. Among these, eight (20.5%) had increase in BUN (average  $\pm$  SD = 54.4  $\pm$  23.1 mg/dl) and two (5.1%) had increases in both BUN (average  $\pm$  SD = 44.8  $\pm$  5.9 mg/dl) and creatinine (average  $\pm$  SD = 3.4  $\pm$  1.3 mg/dl). Alkaline phosphatase (ALP) and alanine aminotransferase (ALT) profiles were measured in 29 and 36 animals, respectively. Increased serum ALP activities were observed in 59.0% of the bitches (n = 17) with mean values of 693 U/l. Two out of 29 dogs (6.0%) had increased ALT activities, with mean value of 102 U/l.

Among 45 bitches with pyometra that had reasonable records concerning their cervical patency, after excluding four referred cases which had received medical treatment elsewhere, survival was 100% (18/18) in those which had open cervix pyometra vs. 81.5% (22/27) in the ones with closed cervix pyometra (*p* = 0.073). No statistical difference (*p* = 1.0) was found between non-treated referrals (89.5%; 17/19) and non-referred cases (88.5%; 23/26), regarding survival among the same 45 bitches with pyometra. Out of 54 bitches subject to surgical treatment, seven died: four during surgery and three on post-surgery. Two bitches subject only to medical treatment recov-

ered uneventfully. Globally, the success rate of treatment for pyometra was 87.5% (49/56).

#### Dystocia

Ten breeds were identified as presenting increased risk for dystocia with an OR from 18.8 to 272.0 (Table 4).

Thirty-two bitches had dystocia, 19 of them due to primary uterine inertia (Table 5). Medical treatment was attempted in 23 bitches (71.9%) and only 2 (8.7%) had successful outcomes. Cesarean sections were performed in a total of 30 bitches (93.8%), including those 21 not responding to the medical protocol and 9 who did not undergo previous medical treatment. No maternal death occurred after parturition or cesarean section in any of the 30 bitches. No dystocia was successfully managed by digital manipulation.

The hematocrit value, determined in only four bitches with dystocia, was 36.3% (range: 34.0-39.0%).

Data was collected on the health of 28 bitches during the month after surgery. Two of the 28 (7.1%) had post-partum complications, one who became anemic and one who had metritis. Data on the litters of those 28 bitches was also obtained. The average litter size was 5.9 pups (range: 1-14) with an average of 4.7 live pups (range: 0-14) at birth, and 4.4 healthy puppies (range: 0-13) 2 months later. Four newborns out of 132 live pups were euthanized due to birth defects. OVH was performed in six (20.0%) out of 30 bitches subjected to caesarean-section.

**Table 4.** Breed as a risk factor for dystocia in bitches.

Breed	Dystocia (%)	OR	CI 95%	<i>p</i> value <sup>1</sup>
Crossbred	0.4	Ref	–	–
Boxer	6.5	18.8	2.1-170.9	0.009
Doberman	11.1	34.0	2.9-395.1	0.005
Chihuahua	20.0	68.0	3.6-1,289.3	0.005
Maltese	25.0	90.7	4.5-1,814.3	0.003
St. Bernard	26.3	97.1	10.6-888.4	< 0.001
Yorkshire Terrier	27.3	102.0	11.6-898.9	< 0.001
Bernese Mountain Dog	40.0	181.3	12.7-2,583.2	< 0.001
French Bulldog	50.0	272.0	17.0-4,359.7	< 0.001
Boston Terrier	50.0	272.0	17.0-4,359.7	< 0.001

OR: odds ratio; CI: confidence interval; Ref: reference (OR = 1.0); <sup>1</sup>Only statistically significant differences are shown (*p* < 0.05).

## DISCUSSION

Limitations of this study comprise the relatively small number of bitches investigated especially among the defined breeds; the fact that these figures from Portugal might not match the situation in the canine populations of other countries; and a hypothetical preference of some defined breed owners to attend this particular hospital, and also missing cases treated in other veterinary centres, which could bias sampling. Thus, caution should be taken when trying to extrapolate these data to the general population of dogs.

Reproductive emergencies are common in small animal veterinary clinics (Biddle and Macintire, 2000). Only pyometra and dystocia had a sizeable representation as reproductive emergencies in the studied population, for the time period considered. Similar to what has been reported elsewhere (Kustritz, 2005), most dogs with pyometra were treated by OVH, which is considered optimal. Use of OVH as the treatment of choice among the dogs in this study was facilitated because most owners were not dog breeders and, thus, maintaining female reproductive potential was not an issue. The 2 dogs treated medically for pyometra were a 13-year old bitch whose owner refused surgery and a young pure-bred bitch with future breeding potential.

It has been suggested that certain breeds (rough Collie, Rottweiler, Cavalier King Charles Spaniel, Bernese Mountain Dog, Golden Retriever and English Cocker Spaniel) are predisposed to pyometra (Egenvall et al., 2001). In the present study, Siberian Huskies represented only 2.4% of the studied population, but accounted for 11.0% of all pyometra cases (Table 1). Two studies described 4-8% mortality rates after surgery for pyometra (Egenvall et al., 2001; Hedlund, 2007). The 13% mortality rate found in the present study can be at least partially attributed to several cases being protracted ill when brought to our facility. Some authors (Fieni, 2006; England et al., 2007) reported success rates of 75-100% after using prostaglandins to treat dogs with pyometra. Two dogs treated with a combination of aglepristone and prostaglandins had a successful outcome, consistent with results in an earlier study (Arnold et al., 2006).

Normocytic normochromic anemia, potentially secondary to bone marrow suppression associated with uterine infection and toxemia, was seen in 33% of the dogs with pyometra. This is similar to results reported by others (Kustritz, 2005; Bartoskova et al., 2007). Similarly, the 80% of bitches with high white blood cell count is consistent with other series (Kustritz, 2005; Verstegen et al., 2008). Assessment

**Table 5.** Causes of dystocia in 32 bitches presenting dystocia as a reproductive emergency.

Cause <sup>1</sup>	No. of dystocia cases	%
Maternal	22	68.8
Primary uterine inertia	19	59.4
Narrow birth canal	3	9.4
Fetal	10	31.2
Fetal oversize	5	15.6
Malpresentation	1	3.1
Fetal death	2	6.2
Unknown	2	6.2
Total	32	100

<sup>1</sup>According to Linde-Forsberg (2010)

of both parameters can be useful in diagnosing and prognosing pyometra. Heiene et al. (2007) found that 18.0-26.0% of bitches with pyometra had azotemia caused by dehydration and possible renal dysfunction. In the present study, 20.5% of bitches with pyometra had increases in BUN but only 5.1% had increases in both BUN and serum creatinine concentrations. An increase of ALP in 50.0-75.0% of cases of pyometra has been reported (Jutkowitz, 2005; Kustritz, 2010) due to reduced liver perfusion, intrahepatic cholestasis and liver cell injury (associated with the cytotoxic necrotizing factor from *Escherichia coli*) and was regarded as the serum biochemistry change more often seen during pyometra. Similarly, ALP was increased in 59.0% of animals in our study. Previous studies have confirmed the reversible nature of ALP increases and the preservation of hepatic function in dogs treated for pyometra, suggesting that intrahepatic cholestasis was the main cause of ALP elevation rather than hepatocellular damage (Fransson, 2003).

Crossbred dogs were the most frequent breed type admitted for reproductive emergencies, but they were not the breed type with the highest frequency of dystocia. In the present study, breeds like Boston terrier, French Bulldog, Bernese Mountain Dog and Yorkshire terrier evidenced higher risk to develop dystocia, which agrees to some extent with previous studies that suggest higher prevalence in brachy-

cephalic, terrier, small and toy breeds (Jutkowitz, 2005). Nevertheless, another study with 182 dystocia cases found no relationship between either breed or age and the occurrence of dystocia (Darvelid and Linde-Forsberg, 1994).

The main cause of dystocia in the bitches included in this study was primary uterine inertia (59.4%; Table 4), defined as occurring when the myometrium produces only weak and infrequent contractions that fail to expel a normal fetus through a normal birth canal (Jutkowitz, 2005). Other groups also found this primary uterine inertia to be the most common cause of dystocia in dogs (Jutkowitz, 2005; Linde-Forsberg, 2005; Kutzler, 2009). It has been estimated that cesarean section is necessary in 60.0-80.0% of dogs with dystocia (Traas, 2008) while in our study surgery was deemed necessary in 94.0%. This higher percentage may have been influenced by a considerable number of referrals from other practices, which had previously received unsuccessful medical treatment. In those cases, as the decision of whether or not to perform a cesarean section after the diagnosis of dystocia needed to be made quickly to preserve the lives of the mother and fetuses, no further medical treatment was pursued. Whenever requested by the owner, OVH was performed after completion of the cesarean section done through incisions in the uterine body or in the uterine horns, and following the delivery of the

litter. The high survival rate of the pups (and mothers) obtained with this protocol supports previous findings (Traas, 2008), that the survival rate of newborns is higher when the cesarean section is performed using this technique rather than the *en bloc* surgery.

### CONCLUDING REMARKS

In conclusion, pyometra and dystocia were the most common reproductive emergencies in the studied setting. Both disorders had preferential resolution through surgical approach, with high rates of success. Normocytic normochromic anemia, high white blood cell count and elevated concentrations of ALP seemed

to be the parameters more frequently associated with pyometra. Some breeds like the Newfoundland and Boston Terrier, as well as the French Bulldog, were found at higher risk of pyometra and dystocia, respectively. Considering the high number of crossbred dogs with pyometra which are generally not intended to be used for breeding, the neutering of these bitches is indicated to prevent life-threatening situations.

### CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest. ■

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