International breeder inquiry into the reproduction of the English bulldog

Voortplanting bij de Engelse buldog: een enquête bij fokkers

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ABSTRACT

Dystocia may occur in all dog breeds, but the English bulldog is predisposed because of its conformation and specific problems such as anasarca pups. In this study, the frequency of abnormal pups and breeding problems in English bulldogs was investigated by a questionnaire containing information on 39 bitches in total. In 74.4% of these bitches, artificial insemination was performed. At the end of gestation, 25.8% of the bitches suffered from respiratory problems and partial anorexia. The average duration of gestation was 58.7 days counted from the first day of mating. Caesarean section was performed in 94.8% of the cases, with natural delivery in only 5.2% of the bitches. In this study, the average litter size was six pups. Thirteen percent of the pups were stillborn, 8.2% of the pups alive were deformed, with palatoschisis (38.8%) and anasarca (27.7%) being the most commonly observed abnormalities. Ten percent of the pups died before the age of weaning.

SAMENVATTING

Dystokie is een probleem bij alle hondenrassen, maar bij de Engelse buldog is het risico hoger omwille van zijn bijzondere conformatie en specifieke problemen zoals waterpups. In deze studie werd de frequentie van abnormale pups en voortplantingsproblemen onderzocht bij de Engelse buldog met behulp van een enquête bij 39 teven. Bij 74,4% van deze teven werd kunstmatige inseminatie uitgevoerd. Bij 25,8% van de teven werden ademhalingsproblemen en anorexia waargenomen aan het eind van de dracht. De dracht duurde gemiddeld slechts 58,7 dagen vanaf de eerste dekking. In 94,8% van de bevallingen werd een keizersnede uitgevoerd, spontane geboorte kwam slechts bij 5,2% voor. De gemiddelde nestgrootte in deze studie was zes pups. Dertien percent van de pups werd dood geboren, 8,2% van de levende pups had een afwijking waarbij palatoschisis (38,8%) en waterpups (27,7%) het meeste voorkwamen. Tien percent van de pups stierf vóór de speenleeftijd.

INTRODUCTION

The English bulldog is a breed that typically displays many health problems caused by its specific anatomical conformation. Traits that were desired when the breed was designed for bull fighting in the 13th century, have led through selective breeding to conformational extremes. Because of the small pelvic canal and the deep position of the pregnant uterus in the bitch combined with the relatively large head and shoulders of the fetus, English bulldogs are very susceptible to dystocia (Jackson, 1995). The overall incidence of dystocia in all dog breeds is 5% of all pregnancies. However, in brachycephalic breeds such as the English bulldog, the risk of dystocia can rise up to 100% (Jackson, 1995; Linde-Forsberg, 2005; Bergstrom et al., 2006). Other breeds with high prevalence of dystocia are achondroplastic breeds, such as Scottish terriers and those selected for a large head, such as Boston terriers and Sealyham terriers (Eneroth et al., 1999). Apart from the breed being a determinant factor, there appears to be an increased risk of dystocia in aged bitches (Forsberg and Persson, 2007). Primiparous bitches older than 6 years have a higher incidence of single-pup pregnancies, or of prolonged parturition and uterine disorders causing dystocia, than younger primiparous bitches (Munnich and Kuchenmeister, 2009). For the boxer breed however, veterinary assistance during parturition is already mandatory from the age of four (Forsberg and Persson, 2007).

In a retrospective study, Darvelid and Linde-Forsberg (1994) determined that 75% of the causes of dystocia were of maternal origin, and 25% were of fetal origin. The most common maternal factor is uterine inertia, which refers to failure to develop and

maintain uterine contractions sufficient for normal delivery (Darvelid and Linde-Forsberg, 1994). Uterine inertia can be classified into primary and secondary inertia. Partial primary inertia occurs when there are sufficient uterine contractions to initiate parturition, but insufficient to deliver any pups. Complete primary inertia occurs when labor fails to start (Vanderweijden and Taverne, 1994). Primary inertia can be due to insufficient stimulation of the uterus when there are only one or two pups (single-pup syndrome), or because of overstretching of the myometrium by large litters (Bennett, 1980; Jackson, 1995). Additionally, genetic predisposition, age, obesity and insufficient physical exercise are causes of primary inertia (Christiansen, 1984). Secondary uterine inertia implies that some of the fetuses are born normally, but the remaining ones cannot be delivered due to exhaustion of the uterine myometrium. This phenomenon may be caused by a large litter or by a prolonged effort to deliver a large or malpresented fetus. Maternal causes of obstructive dystocia include congenital or acquired abnormalities in the size or shape of the pelvic canal. Eneroth et al. (1999) reported that a dorsoventrally flattened pelvic canal is the main cause of dystocia in Scottish and Boston terriers. Additionally, a cephalopelvic disproportion can be present, in which the fetal head is too large for the small maternal pelvic canal.

The most common fetal causes of dystocia are malpresentation, of which transverse presentation (Darvelid and Linde-Forsberg, 1994), and oversized fetuses (Gaudet, 1985) are most frequently observed. In brachycephalic breeds, a ventral deviation of the head is frequently present (Jackson, 1995). Fetal malformations, such as hydrocephalus, cerebral, cerebrospinal or abdominal herniation, may also cause dystocia. Anasarcous fetuses have a congenital abnormality characterized by generalized subcutaneous edema with or without peritoneal, pleural and pericardial effusion (Hopper et al., 2004). Anasarcous fetuses are mostly carried to term, but due to their increased proportions, they can cause problems during parturition, especially during the second phase of delivery. It is a heritable problem in English bulldogs, in which anasarcous pups are the result of a number of recessive gene mutations or structural chromosomal aberrations (Zoldag et al., 2001). The English bulldog is, as other brachycephalic breeds, also very susceptible to palatoschisis (Warzee et al., 2001). Another widespread congenital problem in the English bulldog is the 'swimmer syndrome'. Clinical signs are most obvious when the pups are five or six weeks old and start to walk. At this age, the pups are not able to stand, since the hind legs and occasionally also the front legs are laterally deviated. These pups make characteristic swimming movements (Van Ham, 2002; Verhoeven et al., 2006).

The aim of this study was to investigate the frequency of reproduction-related problems in English bulldog bitches and the congenital health problems in their offsprings. Information was gained from an extensive questionnaire asking English bulldog breeders details about mating, gestation, parturition, caesarean section (CS) and pups.

MATERIALS AND METHODS

Selection of the breeders

An extensive list of breeders was made searching the internet for breeders of English bulldogs. A total of 35 breeders were contacted by letter or e-mail, and those willing to participate in the study received one questionnaire per bitch.

Draft of the questionnaire

The questionnaire contained eight pages with a total of eighty questions. Twenty-five percent were closed questions, and the open questions were deliberately designed to obtain short answers. The questions inquired on the experience of the participating breeders (number of bitches, number of litters per year). The questionnaires were intended for bitches that had had at least one litter (age of the bitch, age at the time of the first litter and the number of litters were determined). A scoring system was developed for previous gestations (1 indicated no problems, 2 problems occurred during the first month, and 3 problems occurred during the second month) and previous deliveries (1 spontaneous delivery, 2 dystocia resulting in CS and 3 elective CS). The closed questions informed on how the optimal mating day was determined. In addition, the question was asked whether or not mating occurred spontaneously, with or without assistance of the breeders or by artificial insemination (AI). The questionnaire also inquired about the number of attempts, and whether the attempts had been successful. If the breeder chose for AI, he had to indicate the specific reason and the materials that had been used to perform the AI. Information on the last gestation, the method of pregnancy diagnosis, potential problems occurring during the gestation period and the length of gestation was also requested. The number of spontaneously born pups was noted. Questions were asked about parturition (start of delivery, progression, number of pups, required assistance, environment, complications and nursing behavior of the bitch). When CS was required, the reason, exact timing, complications of the surgical procedure and the postoperative behavior of the mother were determined. Questions were asked about the anesthetic protocol used during CS. Information was obtained about the number of pups born in the litter, the number of stillborn pups, the identification of the cause of death and the number of pups born with a deformation. Information was also gathered on the prevalence of infections during gestation and after parturition, with a specific interest in herpes virus infections.

Interpretation of the data

Data are presented as the geometric mean, and the range of observations is also mentioned.

RESULTS

Questionnaires

Only 36.1% of the contacted breeders (13/36) participated in the study. Nine breeders were from the Netherlands, three from Belgium and one breeder from the Czech Republic. A total of 39 bitches met the inclusion criteria. The breeders had an average of five dogs (range 3-9).

Breeder experience

The breeders had on average 12 years of experience in breeding English bulldogs (range 2-20 years). Some of them already had several years of previous experience with other breeds. The mean number of litters each breeder had produced, was 16 (range 1-54 litters). The number of litters produced each year was on average 1.6 (range 0.5-3).

Information about the bitch

The average age of the bitches at the time of questioning was 4.7 years (range 2-10.5 years). The average age of the bitches at first gestation was only communicated for 69.2% of the bitches (27/39), and was 25.7 months (range 17-58 months). The number of litters per bitch was on average 2 (range 1-5).

Mating

Data on mating were available in 100% of the bitches (39/39). The methods used for determining the optimal day of mating are presented in Table 1. For two-thirds of the bitches, the correct day of mating was determined by measuring the concentration of progesterone in the blood.

For 74.4% of the bitches (29/39), artificial insemination (AI) using fresh sperm, was performed. Reasons for AI were: to avoid potentially harmful contact with the male dog (48.3%); when natural mating was impossible (20.7%); because AI was deemed a more convenient method (13.7%); to avoid stress (10.3%); because of presumed higher pregnancy rates (3.5%) and because the bitch had not become pregnant after natural mating (3.5%). Most often, AI was performed by a veterinarian (79.3%), except for one breeder who performed the inseminations himself (20.1%). The number of inseminations performed in one period of heat varied: 1 (14.8%), 2 (44.4%), 3 (37.1%) and 4 (3.7%) inseminations were reported. The success rate of AI was 85.2%.

Table 1. Different techniques used to determine the optimal time of mating.

Techniques to determine the time of mating	N	%
Serum progesterone concentration	32	66.6%
Vaginal cytology	2	4.2%
Vaginoscopy	2	4.2%
Behavior of the bitch	2	4.2%
Teaser male	2	4.2%
Combination of methods	8	16.6%

For 23.1% of the bitches (9/39), conception occurred after natural mating; however, assistance by the owner was needed. The number of matings necessary for pregnancy varied: 1 (11.1%), 2 (66.6%) and 4 (11.1%), and in one case (11.1%) the number of matings was unknown. After natural mating, 100% of the bitches (9/9) were pregnant.

For one bitch (2.5%; 1/39), both AI and natural mating occurred in one heat.

Gestation

Gestation was confirmed by ultrasound only in 58.9% of the bitches (23/39), by ultrasound in combination with specific behavioral changes in 20.5% of the cases (8/39), by ultrasound in combination with the determination of serum relaxin concentrations in 10.6% (4/39), and solely based on observing changes in behavior in 10.3% of the bitches (4/39).

The gestation period was most often calculated from the first day of mating, and was 58.7 days (range 50-63 days). Emergency CS resulted in gestation periods of 53 days (range 50-55), and elective CS was performed at 59 days (range: 57-63). Information about the course of the last gestation was only available in 79.5% of the bitches (31/39), and 77.4% of them (24/31) did not have any problems. If problems were reported, they mainly occurred during the second month of gestation. Increased respiratory discomfort, anorexia and discomfort in recumbency were most commonly observed. But also vomiting and edema were mentioned, and one bitch developed an inguinal hernia.

One bitch with early pregnancy confirmed by ultrasound, resorbed the embryos later in gestation.

Parturition

Natural delivery was only allowed in 5.1% of the bitches (2/39). The parturitions proceeded in a quiet environment, with the owner present to assist if necessary. The first bitch delivered three litters in total with an average of 8.0 pups (range 6-9). Only 4.2% of the pups (1/24) died during or shortly after parturition. The parturitions were completed in 4 to 8 hours. Assistance was limited to the removal of fetal membranes in some pups and severing of the umbilical cord in all pups.

The second bitch had three litters with an average of 8.0 pups (range 6-10). Neonatal death occurred in 37.5% (9/24 pups). The parturitions took 37 hours (13-56 hours). The assistance consisted of oxytocine administration, the removal of fetal membranes and severing of the umbilical cord.

Natural delivery resulted in 79.2% (38/48 pups) live pups at birth.

Table 2. Different techniques to determine the optimal time for elective caesarean section.

Timing of elective caesarean section	N	%
Decrease in rectal temperature	16	48.5%
Decrease in rectal temperature and behavior	6	18.2%
Physical condition of the bitch	5	15.2%
Drop in rectal temperature, nesting behavior and milk production	3	9.1%
Decrease in rectal temperature, contractions and amniotic fluid	2	6.1%
Exclusively based on the day of mating	1	3.0%

Table 3. Reported neonatal pathologies.

Disability	N	%
Cleft palate	7	38.8%
Anasarcous puppy	5	27.7%
Deaf puppy	2	11.1%
Unilateral deaf puppy	1	5.5%
Omphalocoele	1	5.5%
Swimmer syndrome	1	5.5%
Distorted head	1	5.5%

Caesarean section

Caesarean section was performed in 94.8% (37/39 bitches) of the parturitions. Cesarean section was performed as an elective procedure in 89.2% of the bitches (33/37) and as an emergency procedure in 10.8% (4/37). The reason for breeders to plan CS was the known high risk of dystocia in the breed. The timing of elective CS was determined by the decrease in rectal temperature (48.5%), the temperature decrease combined with nesting behavior (18.2%), the deteriorating physical condition of the bitch (15.2%), nesting behavior and milk production (9.1%) and contractions of the abdomen and expulsion of amniotic fluid (6.1%), based on the day of mating (3.0%) (Table 2). Cesarean section resulted in 85.1% (279/328) of the pups alive at birth.

The anesthetic protocol was reported in 73.0% of the bitches (27/37). For the surgeries performed in Belgium (29.6%; 8/27), general anesthesia was used, while the procedures in the Netherlands (70.4%; 19/27) were performed using sedation and local anesthesia. Data on complications related to CS were available in 81.1% of the bitches (30/37). Peroperative mortality was 6.6% (2/30), and postoperative complications (wound infections) occurred in 16.6% of the bitches (5/30).

Information about maternal behavior after CS was reported in 70.3% of the dogs (26/37). Maternal behavior was present immediately after anesthetic recovery in 65.4% of the bitches (17/26), within 24 hours in 11.5% (3/26), and only after a few days in 7.7% (2/26). In 15.4% (4/26), normal maternal behavior was not obvious. Three of those litters were raised by hand because of neonatal-directed aggression or insufficient milk production. Two of those litters died because they were fed an erroneous milk replacer. One litter was raised by a foster mother.

Pups

The mean number of pups in the most recent litters was six pups (range 1-12). Neonatal pathologies occurred in 8.2% of the pups (18 of the 220 pups which were born alive) (Table 3). Cleft palate (38.8%; 7/18) and anasarca (27.7%; 5/18) were the most commonly observed abnormalities. In this study, 5.5% of the pups (1/18) showed symptoms of the "swimmer syndrome"

Ten percent of the pups (23/220) died before the age of weaning. More than half of those pups (52.2%; 12/23) died because of a presumed herpesvirus infection, 26.1% of the pups (6/23) died because they were fed an erroneous milk replacer, one pup with swimmer syndrome died (4.5%), and one pup died because of pathological growth of the bones (4.5%). In 26.1% (6/23) of the pups, the cause of death was unknown.

DISCUSSION

In this study, only a small percentage (36.1%) of the English bulldog breeders that were contacted, were willing to participate. The high non-response rate could be due to the fact that breeders were contacted by letter or e-mail, instead of by phone, and that no reminder was sent. Another potential bias is that breeders were not always willing to share specific parts of information resulting in unanswered questions. In this type of study, the negative outcome of previous parturitions can possibly influence the motivation of a breeder to communicate these data, which may also be the reason why some breeders did not answer all the questions (Forsberg and Persson, 2007). Nevertheless, based on the information from the breeders who answered the questionnaire, it may be confirmed that the English bulldog is a breed with many obstetrical problems. English bulldogs are very susceptible to dystocia. This is the main reason why most breeders prefer an elective CS. One participating breeder, from the Czech Republic, had two bitches that repeatedly delivered litters naturally. With assistance of the owner, who removed the fetal membranes from the pups, natural delivery resulted in a total of 48 pups (6 litters). In Belgium and in the Netherlands however, no successful spontaneous deliveries in English bulldogs were reported. Only four bitches were allowed to deliver naturally, but they soon were too exhausted, and an emergency CS had to be performed. Since puppy mortality is associated with neonatal hypoxia time, the duration of the expulsion stage has a high influence on puppy mortality (Munnich and Kuchenmeister, 2009). This study found puppy mortality rates of 14.9% after CS and 20.8% after natural delivery, confirming that elective CS is the method of choice in this breed. However, in this

study, preoperative mortality before CS was 6.6%, while none of the bitches died during natural mating. Breeders chose elective CS as delivery method in 89.2% of the litters. This is comparable to the results of Evans and Adams (2010), reporting that 86% of all litters of English bulldogs in the UK are born after CS. Together with Boston terriers and French bulldogs, English bulldogs have the highest rate of CS out of 156 investigated breeds (Evans and Adams 2010). In the present study, most of the bitches had more than one CS, except when problems occurred during the first gestation. Most of the contacted breeders considered three CS per bitch as a maximum, but occasionally up to five CS were performed in the same bitch. The Dutch kennel club for English bulldogs recommends not to have more than three deliveries per dam, while the Belgian kennel club advices not more than four deliveries per bitch. Since January 1st 2012, the kennel club of the UK no longer registers pups born after CS from a bitch that previously had two such operations (Kisko, 2010). An international consensus on a restricted number of allowed CS should be used as selection force to change the future of certain dog breeds. After CS, maternal behavior was not or not immediately present in 34.6% of the bitches. This finding has already been described in the literature: a bitch may ignore her pups as a possible complication after CS, or when the pups are delivered before 57 days of gestation (Beaver, 2009).

In this study, the size of the English bulldog litters was six on average. This concurs with the retrospective study performed by Borge et al. (2011), who found an average litter size for the English bulldog of 5.4 pups (in 37 litters). In that study, of all neonates, 8.2% had a fetal pathology, of which palatoschisis and anasarcous feti were the most common. It is described that brachycephalic breeds, as the English bulldog, may have up to a 30%-risk factor for palatoschisis (Ingwersen, 2005). In the present study, this factor was more frequently observed when certain stud-bitch combinations were used, with one litter of three pups, with 100% having a cleft palate. Although human medicine has shown that 25-30% of palatoschis is due to a genetic component, in dogs little is known about the genetic cause (Van den Berghe et al., 2010). For anasarcous pups, a familial predisposition has been determined in the English bulldog (Hopper et al., 2004). Zoldag and coworkers (2001) suggest that for English bulldogs, anasarcous pups are caused by a genetic factor, since more problems occur when using certain male dogs and when the bitches are randomly chosen. Despite the previously reported predisposition of the English bulldog for the "swimmer syndrome" (Van Ham, 2002; Verhoeven et al., 2006), only one case was reported in this study.

Most breeders in the present study preferred AI over natural mating because they thought it was more convenient, caused less stress for the bitch and avoided possible transmission of venereal infections, such as herpes virus infections. Some breeders specifically chose AI when the bitch did not become pregnant after natural mating, while others started with AI and turned to natural mating when AI was unsuccessful. Most breeders in this study used the concentration of blood progesterone to determine the moment of ovulation and subsequently the optimal moment of mating, which is described as the most reliable method (Bouchard et al., 1991). None of the breeders involved in this study used frozen semen, only fresh semen was used, and in some cases the male dog was present at the moment of AI. Belgian legislation states that artificial insemination in dogs, contrary to cows and horses, should be performed by a veterinarian. Nevertheless, one breeder of the inquiry performed the inseminations himself. The Dutch veterinarians frequently stimulated the perineum after AI, while the Belgian veterinarians lifted the hind quarters of the dog for 10 minutes. Both techniques intend to reduce sperm loss and to stimulate sperm transport. In studies on AI with fresh semen of dogs with normal fertility, no differences were observed when the time of lifting the hind quarters was reduced from 10 to 1 minute (Pinto et al., 1998). No studies are available on the effect of perineum stimulation on dog fertility. The true benefit of these interventions still has to be established. In the small number of bitches in which fertilization occurred by natural mating, assistance of the owner or the use of a pillow as a step was required so that the male dog was able to mount the female.

The experience of the participating breeders was very diverse: some breeders were familiar with breeding English bulldogs, and some of them had just started. None of the breeders had more than three litters per year, mainly due to the limited number of dogs per breeder (up to nine dogs), but partly also due to the pressure of work involved in dog breeding.

In conclusion, it can be stated that breeding English bulldogs holds many potential problems during pregnancy and parturition. While natural delivery remains possible in some bitches, elective CS avoids some of the associated delivery problems and results in higher neonatal survival. Blood lines with anasarcous pups should be identified, and banned from breeding in order to eradicate their persistence.

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Uit het verleden

DE PAARDENVOET: HET FUNDAMENT

Xenophon, omstreeks 360 v.C.

De *Peri Hippikès* van de Atheense veldheer en geschiedschrijver Xenophon is het oudste complete rijtheoretische geschrift dat tot ons gekomen is. Een karakteristiek fragment geeft ons een stevig idee van het belang van paardenvoeten.

Want evenals een huis niets waard is, als weliswaar de bovenbouw mooi is, maar er geen behoorlijke fundamenten onder zitten, zo zou ook het krijgspaard niets waard zijn - ook niet als het overigens alle goede eigenschappen bezit – wanneer het slechte voeten heeft, want dan zou het van al die goede eigenschappen geen gebruik kunnen maken.

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Luc Devriese