# Comparison of short-term complications following Cesarean section or Cesarean section with concurrent ovariohysterectomy in bitches and queens: a pilot study

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## Abstract

Cesarean section is a common treatment for canine and feline dystocia. Ovariohysterectomy may or may not be recommended concurrently. There are apparently no data in the literature providing evidence to guide decision-making regarding the advantages and disadvantages of performing these procedures concurrently. Animal signalment, history upon presentation, medical and anesthetic management of dystocia, and incidence of short-term complications were compared between bitches and queens undergoing Cesarean section alone and those undergoing concurrent Cesarean section and ovariohysterectomy. Short-term complications were defined as those happening after recovery from anesthesia and extubation and within several days after patient discharge. Complete data were available for two queens undergoing Cesarean section alone and two queens undergoing concurrent Cesarean section and ovariohysterectomy, and for 20 bitches undergoing Cesarean section alone and 22 bitches undergoing concurrent Cesarean section and ovariohysterectomy. No short-term complications were reported in any of these patients. An important limitation was small sample size; therefore, further investigations, perhaps by pooling data from several institutions, would be beneficial.

**Keywords:** Cesarean section, dystocia, ovariohysterectomy, spay, bitch, queen

## Introduction

Reported incidence of dystocia is 2.0-5.0% and 3.3-5.8% in dogs and cats, respectively, with a predisposition in some breeds.[1-9] Cesarean section (C-section) is performed in 54-66% of dogs and in 74-79% of cats with dystocia.[1,4-6,10] Reported complications of C-section include hemorrhage, infection or dehiscence of the incision, and peritonitis.[2,11,12] Complications may occur due to underlying disease in the animal or surgeon error.[12] Mortality rate for the bitch or queen during or immediately after C-section is 0-2%.[11,13]

It is not uncommon for veterinarians to recommend or for clients to request ovariohysterectomy (OHE) at the time of C-section. Reasons to conduct the two procedures concurrently include: the bitch is spared a subsequent anesthetic episode (assuming she will be spayed later); bitches that require C-section should not be rebred, which may or may not be true depending on the cause of the dystocia and the reason for the C-section; uterine pathology, e.g. uterine rupture or infection; and this is an opportunity to perform OHE for population control.[10,14] Some argue that risks of concurrent C-section and OHE are excessive. It is not difficult to expect increased morbidity and potentially increased mortality in bitches and queens undergoing two invasive surgical procedures concurrently. Blood pressure rises when the linea alba is incised and as ovaries are manipulated in healthy bitches undergoing OHE.[15-17] Commonly reported complications of OHE include: hemorrhage at the ovarian pedicle or from other intra-abdominal vessel; inadvertent ligation of the distal ureter; trauma to other intra-abdominal organs; persistent bloody vulvar discharge; and infection or dehiscence of the incision.[17-28] Reported concerns specific to concurrent C-section and OHE are: lack of milk production due to dehydration, anemia, or uncontrolled pain post-surgically; hemorrhage; and decreased mothering responses.[29] Other possible concerns with concurrent OHE and C-section are physiologic responses in the dam, including: changes in blood pressure or hematologic parameters secondary to removal of the blood-filled uterus and associated placental tissues; increased duration of anesthesia and surgery if procedures are performed concurrently, with associated complications such as hypothermia and tissue damage; and ethical concerns for the bitch.

Veterinarians, breed clubs, and others interested in ensuring optimal health of breeding bitches rely on scientific literature to help them make decisions. In one retrospective study, number of days hospitalized and complications were reportedly higher in 10 bitches that had undergone both C-section and OHE than in those that had undergone C-section alone.[1] Complications were not described in that

study. Other studies described overall complications of populations of animals undergoing either C-section or OHE, some of which likely underwent both procedures, but again without comparing complications between C-section or OHE alone and the two surgeries performed concurrently.[4,6,10,19] The author is unaware of any published studies specifically evaluating short-term complications of C-section versus C-section with concurrent OHE.

The goals of this pilot study were to identify reported short-term complications associated with C-section alone versus C-section with concurrent OHE and to identify trends in patient signalment or medical and anesthetic management of these cases that may have contributed to development of complications.

## Materials and methods

The electronic medical record was searched for the procedure code for C-section. Complete records were either available electronically or hard copies were retrieved to ensure that the author had all available data. Data recorded included signalment, history upon presentation, and medical and anesthetic management. Breed but not weight was recorded, as weight varies in late gestation (due to litter size). Similarly, body condition score was not reported because it can be difficult to assess in late-gestation bitches. Short-term complications were defined as those happening after recovery from anesthesia and extubation and within several days after patient discharge.

## Results

The electronic medical record was searched from 2001 through 2017. Fifty-four medical records were identified. Five records were incomplete. Three bitches were presented for hysterotomy due to pregnancy loss of undefined cause (n = 1) or for removal of a non-viable fetus and fetal membranes (n = 2). Of the remaining cases, four were queens, two of which underwent C-section alone and two that underwent C-section with concurrent OHE, and 42 were bitches, 20 of which underwent C-section alone and 22 that underwent C-section with concurrent OHE.

History and management of the queens are shown (Table 1). Anesthetic protocol was only reported in detail for the two queens that underwent C-section with concurrent OHE; one queen received midazolam and butorphanol and was maintained on sevoflurane, whereas the other was induced with propofol and maintained on sevoflurane. Reason for the concurrent OHE was not reported in either queen. All kittens were born alive and discharged with the dam. No short-term complications were reported for any queens.

History and management of the 20 bitches that underwent C-section alone are shown (Table 2). Mean $\pm$ SD age at the time of presentation was 4.2 $\pm$ 1.8 years. Breed was variable, with no breed over-represented. Three bitches were of toy breeds and one was of a giant breed. Anesthetic protocol was reported in detail for 10. Two were maintained on isoflurane and also received propofol (n = 1) and alfaxalone (n = 1). Eight were maintained on sevoflurane and also received hydromorphone and propofol (n = 4); hydromorphone, diazepam, and propofol (n = 2); fentanyl and propofol (n = 1), or diazepam and propofol (n = 1). Two bitches suffered transient hypotension under anesthesia that responded to medical therapy. All pups were born alive and sent home with the dam for 13 bitches; all pups were stillborn, could not be resuscitated, or had congenital defects incompatible with life at the time of C-section for four bitches; and there was a combination of live and stillborn pups for three bitches. No short-term complications were reported for any bitches that underwent C-section alone. One bitch on a raw, homemade diet had a poor appetite and was not attentive to the pups the first day after surgery; however, that resolved after she was fed a commercial diet.

History and management for the 22 bitches that underwent C-section and concurrent OHE are shown (Table 3). Mean age at the time of presentation was 4.2 $\pm$ 2.0 years. Breed was variable, with no breed over-represented. Five bitches were of toy breeds and one was of a giant breed. Reason for the concurrent OHE was unreported in 21 bitches, whereas a uterine tear was present in one bitch. Anesthetic protocol was reported in detail for 13. Seven were maintained on isoflurane and also received alfaxalone (n = 2); propofol (n = 2); atropine, midazolam, hydromorphone, and propofol (n = 1); diazepam,

hydromorphone, and propofol (n = 1); hydromorphone and propofol (n = 1). Six were maintained on sevoflurane and also received hydromorphone and propofol (n = 2); atropine, hydromorphone, and propofol (n = 2); diazepam, hydromorphone, and propofol (n = 1); and fentanyl and propofol (n = 1). One bitch with aspiration pneumonia in late gestation had a prolonged capillary refill time and a decline in PCV from 35 to 19% intra-operatively; she responded to transfusion with packed RBCs. One bitch with pregnancy toxemia had an unreported decline in PCV intra-operatively; she responded to transfusion with blood products. One bitch with respiratory distress had low oxygen saturation and could only maintain normal oxygen saturation after intubation and oxygen therapy; however, this resolved after surgery, and she had a prolonged but uneventful recovery. All pups were born alive and sent home with the dam for 13 bitches; all pups were stillborn, could not be resuscitated, or had congenital defects incompatible with life at the time of C-section for three bitches; and there was a combination of live and stillborn pups for six bitches. No short-term complications were reported for any bitch that underwent C-section with concurrent OHE.

**Discussion**

In this study, no short-term complications were noted either for C-section alone or for C-section with concurrent OHE. All cases were managed in a referral hospital where the receiving clinician had immediate access to a board-certified theriogenologist and all procedures were completed by board-certified anesthesiologists and surgeons. This, coupled with availability of pharmaceuticals and monitoring equipment that may not be available at all facilities, may have decreased the likelihood of complications.

One limitation of this study was the limited number of cases. This is a referral hospital in a large metropolitan area with many clinics that offer high-quality small animal reproductive services, which limits such cases presenting to the author's institution. Another limitation was a lack of complete follow-up on all cases, as some undoubtedly were presented solely because emergency service was available and they subsequently completed follow-up with their regular veterinarian. For many cases, complete analysis of records permitted the author to access information from telephone conversations with clients in the days following surgery. A final limitation, common in retrospective studies, was the lack of consistent data in medical records. For example, surgical reports often did not clarify if OHE had been performed post-hysterotomy or if an *en bloc* OHE had been performed. This could have affected incidence of short-term complications. In one study describing *en bloc* OHE as a treatment for dystocia, examples of post-surgical complications included: anemia requiring blood transfusion in three queens; disseminated intravascular coagulation (DIC) in a queen; bloody vulvar discharge in a bitch; uroperitoneum in a bitch; and death of a queen.[30]

As another example, use of pre- or intra-operative antibiotics was variably recorded. For many cases, antibiotic use was identified by the author reviewing the anesthesia record, the surgical record, the pharmacy request screen, or the final bill. Consequently, there was limited ability to determine when the antibiotic had been administered. Presumably some bitches received antibiotics and it either was not recorded or was not retrieved. Consequently, use of pre- and intra-operative antibiotics could not reliably be reported. Data regarding dispensed antibiotics were consistent in the record, as described above. Use of antibiotics generally is not required unless there is systemic infectious disease, ongoing uterine pathology in bitches or queens left intact, or contamination of the peritoneal cavity with uterine contents during either C-section or OHE.[11] The rationale for using or withholding antibiotics was not consistently apparent.

Two studies evaluating post-surgical complications in dogs and cats based on retrieval of hard copy or electronic records demonstrated under-reporting in computer records.[19,23] Both hard copies and electronic records had some deficiencies in this study, more likely due to lack of training and tracking of record completion, rather than variation in the medium used.

Most studies in dogs and cats identify uterine inertia as the most common cause of dystocia.[1,4,10,30] In a study describing 510 C-section procedures in 453 bitches, lack of progression of labor was the

reported cause of dystocia in 73.1% of cases.[2] However, in the present study, specific causes of dystocia were difficult to identify from the medical record.

Variability of breed and range of age of bitches and queens in this case series matched those reported in the literature.[2,13] Increased body weight was associated with increased incidence of complications of OHE in several studies.[17,20] That was not supported by data in this study, although weight of the bitches and queens in this case series was not retrieved from the medical record, due to concerns regarding inability to differentiate lean body weight from pregnancy weight, with varying litter size.

Various anesthetic protocols were used, consistent with the literature.[2,13] The lack of short-term complications precluded making associations with medical or anesthetic management. However, the variability of medical and anesthetic management protocols suggests that such associations would be unlikely unless sample size or the effect were large. The author looks forward to other publications with larger sample sizes, perhaps as a collaborative effort from several institutions, to provide more definitive evidence.

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**Table 1**. Signalment and case management data for queens undergoing Cesarean section alone or Cesarean section with concurrent ovariohysterectomy.

| PROCEDURE | BREED / AGE | PRESENTING HISTORY | RADIOGRAPHS / ULTRASOUND | OXYTOCIN THERAPY? | PRE-ANESTHETIC BLOODWORK | ANTIBIOTICS DISPENSED AT DISCHARGE |
|---|---|---|---|---|---|---|
| C-section only | Abyssinian / 4 years | Lethargy, variable anemia over the last week | Radiographs and ultrasound | No | PCV 23% | No |
| C-section only | DSH / 1 year | Prolonged labor, one stillborn kitten born at home | Radiographs | Yes – two live kittens born | PCV 38% | No |
| C-section with concurrent OHE | Siamese / 3 years | Prolonged labor | Radiographs and ultrasound | No | PCV 39%, HGB 13.3 gm/dL | No |
| C-section with concurrent OHE | DSH / 4 years | Prolonged labor, history of pelvic fracture | Radiographs | No | PCV 29%, platelet number normal (estimate) | No |

**Table 2.** Signalment and case management data for bitches undergoing C-section alone.

| BREED / AGE | PRESENTING HISTORY | RADIOGRAPHS / ULTRASOUND | OXYTOCIN THERAPY? | PRE-ANESTHETIC BLOODWORK | ANTIBIOTICS DISPENSED AT DISCHARGE |
|---|---|---|---|---|---|
| English bulldog / 2 years | Prolonged labor, green vulvar discharge | Ultrasound | No | PCV 44%, HGB 15.2 gm/dL | No |
| English bulldog / 2 years | Green vulvar discharge 4 days prior to planned C-section | Radiographs | No | PCV 41%, HGB 13.9 gm/dL | Yes |
| Standard poodle / 2 years | Prolonged labor | None reported | Yes – no effect | PCV 36%, HGB 12.4 gm/dL, platelet number 389,000 | No |
| American bulldog / 2 years | Prolonged labor | None reported | Yes – no effect | None reported | No |
| Bernese mountain dog / 3 years | Planned C-section as bitch entered labor | Radiographs | No | PCV 52%, HGB 17.8 gm/dL, platelet number 326,000 | No |
| English cocker spaniel / 3 years | Prolonged labor | Radiographs | Yes – no effect | PCV 29%, HGB 9.9 gm/dL | Yes |
| Labrador retriever / 3 years | Stillborn the day before, no contractions since. | Radiographs and ultrasound | Yes – 6 pups born live | PCV 42%, HGB 14.3 gm/dL | No |
| Labrador retriever / 3 years | Prolonged labor, referring DVM gave oxytocin to no effect | Radiographs | Yes – 2 pups born live | PCV 32%, HGB 10.9 gm/dL | No |
| Bernese mountain dog / 4 years | Five pups born live at home, prolonged labor for final pup | Radiographs | No | PCV 38%, HGB 12.9 gm/dL | No |
| Siberian husky / 4 years | Prolonged labor | Radiographs | No | PCV 37%, HGB 12.9 gm/dL, platelet number 531,000 | No |

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|---|---|---|---|---|---|
| Chihuahua / 4 years | Prolonged labor, two pups born live at home that later died | Radiographs | Yes – no effect | None reported | No |
| Pug / 4 years | Prolonged labor | Radiographs and ultrasound | No | None reported | No |
| Italian greyhound / 4 years | Prolonged labor, had received dexamethasone earlier in pregnancy for mismating | Radiographs | No | PCV 34%, HGB 11.7 gm/dL | Yes |
| Siberian husky / 5 years | Elective C-section | None reported | No | None reported | No |
| Dachshund / 5 years | Prolonged labor | Radiographs | Yes – 1 pup born live | None reported | No |
| Siberian husky / 6 years | Elective C-section for single, large puppy | Radiographs | No | None reported | No |
| Collie / 6 years | Prolonged labor | Radiographs | Yes – 2 pups stillborn | PCV 39% | No |
| Irish Wolfhound / 7 years | Prolonged labor, bitch in atrial fibrillation and heartworm positive | None reported | No | PCV 34%, HGB 12.2 gm/dL | No |
| Samoyed / 7 years | Prolonged labor, one live pup and one stillborn at home | None reported | No | None reported | Yes |
| Afghan hound / 8 years | Prolonged labor | Radiographs | Yes – no effect | PCV 45%, HGB 15.2 gm/dL | Yes |

**Table 3.** Signalment and case management data for bitches undergoing concurrent C-section and OHE.

| BREED / AGE | PRESENTING HISTORY | RADIOGRAPHS / ULTRASOUND | OXYTOCIN THERAPY? | PRE-ANESTHETIC BLOODWORK | ANTIBIOTICS DISPENSED AT DISCHARGE |
|---|---|---|---|---|---|
| Pug / 1 year | Prolonged labor | None reported | No | None reported | Yes |
| Chihuahua / 1 year | Prolonged labor | Radiographs | No | PCV 42%, HGB 14.3 gm/dL | No |
| Yorkshire terrier / 2 years | Prolonged labor, one live and one stillborn pup at home | Ultrasound | No | PCV 37%, HGB 12.6 gm/dL | No |
| Golden retriever / 2 years | Respiratory distress in late gestation / diagnosed with aspiration pneumonia | Radiographs and ultrasound | No | PCV 35%, HGB 11.9 gm/dL, prolonged CRT | Yes |
| Rottweiler / 2 years | Prolonged labor | Radiographs | No | PCV 39%, HGB 14.0 gm/dL | No |
| Pomeranian / 3 years | Prolonged labor, prior history of pelvic injury | Radiographs | No | PCV 34%, platelet number increased (estimate) | Yes |
| Bernese mountain dog / 3 years | Prolonged labor | Ultrasound | No | PCV 39% | No |
| Dachshund / 3 years | Tarry stools, lethargy / diagnosed with pregnancy toxemia | Radiographs | No | PCV 25% | No |
| American Staffordshire terrier / 3 years | Prolonged labor, two live pups born at home and then labor stopped | Radiographs and ultrasound | No | PCV 34%, HGB 11.6 gm/dL | No |
| English bulldog / 4 years | Respiratory distress in late gestation | None reported | No | PCV 35%, HGB 12.0 gm/dL | No |
| Labrador retriever / 4 years | Prolonged labor, concurrent stage II vaginal hyperplasia. Five pups born live at home | None reported | No | None reported | No |
| Golden retriever / 4 years | Prolonged labor | Radiographs | Yes – no effect | PCV 41%, HGB 14.4 gm/dL, | Yes |

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|---|---|---|---|---|---|
| | | | | platelet number normal | |
| Pug / 5 years | None reported | Radiographs | No | None reported | Yes |
| American Staffordshire terrier / 5 years | Prolonged labor, green vulvar discharge | Radiographs | No | PCV 39%, HGB 13.9 gm/dL | No |
| Miniature pinscher / 5 years | Overdue based on breeding dates, temperature dropped to 99°F four days ago, intermittent contractions | Radiographs | No | PCV 41%, HGB 14.5 gm/dL | No |
| Cavalier King Charles spaniel / 5 years | Prolonged labor | Radiographs | Yes – 2 pups born live | PCV 45%, HGB 15.3 gm/dL | No |
| English setter / 6 years | Prolonged labor, green vulvar discharge | None reported | No | PCV 39%, HGB 13.3 gm/dL | No |
| Bearded collie / 6 years | Prolonged labor | Radiographs | No | PCV 41% | No |
| Irish wolfhound / 6 years | Prolonged labor, 2 pups born live at home | Radiographs | No | PCV 37%, HGB 16 gm/dL, normal platelet number (estimate) | No |
| Whippet / 7 years | Prolonged labor, green vulvar discharge | Radiographs | No | PCV 41% | Yes |
| Bichon fries / 7 years | Prolonged labor, two stillborn at home | Radiographs | No | PCV 34%, HGB 11.6 gm/dL | No |
| Samoyed / 9 years | Prolonged labor, gave birth to 9 pups at home | Radiographs | Yes, by owner | PCV 32% | No |