Commentary

Ovariohysterectomy versus ovariectomy for elective sterilization of female dogs and cats: is removal of the uterus necessary?

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Elective sterilization of female dogs and cats is one of the most common procedures performed in veterinary practice and is considered by private veterinary practitioners as one of the most important skills required of new graduates.[1,2] Potential benefits of sterilization include population control, prevention of diseases of the reproductive tract, and elimination of undesirable behaviors associated with hormonal cycling. The AVMA[3] and the Association of Shelter Veterinarians[4] both promote elective sterilization of female dogs and cats as integral to reducing euthanasia of unwanted dogs and cats.

Sterilization of female dogs and cats can be accomplished by removing both the ovaries and uterus (ovariohysterectomy) or by removing the ovaries alone (ovariectomy). Ovariohysterectomy has historically been recommended in the United States and Canada and is currently emphasized at schools and colleges of veterinary medicine in these countries. To our knowledge, only one of the most frequently used surgical textbooks in the United States and Canada describes ovariectomy,[5] and ovariectomy is generally not taught to veterinary students during their surgical laboratories. The Clinical Proficiency Examination, which is the final step in the Educational Commission for Foreign Veterinary Graduates' program for establishing the educational equivalence of graduates of nonaccredited veterinary schools seeking licensure in the United States or Canada, requires "complete removal of both ovaries and removal of the majority of the uterus" to obtain a passing grade.[6]

Despite the apparent preference for ovariohysterectomy in the United States and Canada, ovariectomy appears to have become the standard of care in many European countries.[7] In addition, with the development of minimally invasive surgical techniques, laparoscopic ovariectomy has gained popularity.[8] Thus, it may be helpful to review the scientific evidence comparing ovariohysterectomy and ovariectomy for elective sterilization of healthy female dogs and cats.

Surgical Technique

Ovariohysterectomy and ovariectomy involve similar surgical techniques, except that the skin and fascia incisions are considerably smaller and located more cranially with ovariectomy, compared with ovariohysterectomy.[9] In one study,[9] for instance, mean skin incision length was 19.8% of the manubrium-to-pubic brim distance in dogs undergoing ovariectomy and 23.8% in dogs undergoing ovariohysterectomy. Mean fascia incision length was 17.7% of the manubrium-to-pubic brim distance in dogs undergoing ovariectomy and 21.3% in dogs undergoing ovariohysterectomy. The suspensory ligament must be broken down with either procedure to allow identification of the ovaries, and with both procedures, the ovarian pedicles are ligated and severed. With ovariohysterectomy, however, the uterine vessels are also ligated and the uterus is crushed and severed. Surgery time is approximately the same for both ovariohysterectomy and ovariectomy, and it is likely that with experience, each procedure is of equal technical difficulty.[9] Minimally invasive surgical techniques are being used with increasing frequency for elective sterilization of female dogs, and it is the authors' opinion that ovariectomy is easier to perform than ovariohysterectomy with these techniques.

Signs of Pain

A recent prospective clinical trial[9] compared signs of pain in dogs undergoing ovariohysterectomy or ovariectomy. Scores for the Glasgow composite measure pain scale were not significantly different between groups, and rescue analgesia was not required for any dog. However, all dogs were premedicated with carprofen prior to surgery and received buprenorphine for the first 24 hours after surgery and carprofen thereafter, which might have masked any differences that may have existed. Studies[10–13] comparing laparoscopic with open sterilization techniques have generally identified fewer and less severe signs of pain in dogs undergoing laparoscopic procedures, possibly as a result of the smaller incision and decreased tissue handling associated with laparoscopic techniques, compared with open techniques.

Complications

Surgical complication rates associated with ovariohysterectomy in healthy dogs and cats have been reported to range from 6.2% to 20.6%, depending on sur-

geon experience.[14,15] Most complications are mild and generally consist of incisional inflammation or gastrointestinal tract upset. Incisional complications are more common in larger animals and animals with longer surgery and anesthesia times.[15] Although the overall complication rate after ovariectomy has not been evaluated in a large group of animals, no difference in surgery time or wound scores was noted in a small prospective study[9] in which ovariohysterectomy was compared with ovariectomy.

Intra-abdominal hemorrhage during or after surgery has been reported in 6.4% to 20% of dogs undergoing ovariohysterectomy, most often in dogs weighing > 22.7 kg (49.9 lb) and in procedures performed by inexperienced surgeons.[7,15,16] Bleeding occurs most frequently from the right ovarian pedicle but may also occur from the left ovarian pedicle, broad ligament, uterine arteries, uterine stump, or body wall. The incidence of intra-abdominal hemorrhage with ovariectomy has not been reported, but it has been theorized that bleeding may be less likely because only the ovarian pedicles are potential sources of blood loss.[7,9] With either procedure, severe life-threatening hemorrhage is rare.[15,16] Vaginal bleeding, reported in up to 15% of dogs that undergo ovariohysterectomy, would not be expected to occur after ovariectomy because ligatures are placed around the proper ligament of the ovary, leaving the serosal surface of the uterine horns intact.[7,17]

Inadvertent ligation of a ureter is an uncommon but potentially severe complication of either ovariohysterectomy or ovariectomy. Ligation can occur proximally in association with ligation of the ovarian pedicle or distally in association with ligation of the uterine stump.[18] It has been suggested that ligation of the distal portion of the ureter is more likely to occur because of its intraperitoneal location and close proximity to the uterine body.[7] Ligation of the distal portion of the ureter would not be expected with ovariectomy because all ligatures are placed in close association with the ovary.

Excessive inflammation and granuloma formation, manifested clinically as a draining fistulous tract, can occur after either ovariohysterectomy or ovariectomy. In general, this complication is associated with excessive tissue trauma, poor aseptic technique, and the use of braided nonabsorbable suture material. Granuloma formation can occur at either the ovarian pedicle or uterine stump after ovariohysterectomy but is more frequently identified at the uterine stump.[17–19] Granulomas would be expected to occur only at the site of the ovarian pedicle following ovariectomy.

Ovarian remnant syndrome (ORS) is a disorder characterized by clinical signs related to functional residual ovarian tissue after ovariohysterectomy or ovariectomy. To our knowledge, no studies have reported identifying ectopic ovarian tissue in dogs; therefore, ORS is considered to exclusively be a result of functional tissue remaining after surgery. Retrospective studies[17,19] indicate that ORS represents 17% to 43% of all complications after ovariohysterectomy and is more common with inexperienced surgeons. Dogs have a higher likelihood of developing ORS, compared with cats, and the right ovary is more likely to be involved because of its more cranial location.[20] No studies have compared the incidence of ORS in dogs that have undergone ovariohysterectomy versus ovariectomy, but it has been suggested that ORS would be less likely to develop after ovariectomy because the more cranial location of the incision may allow better exposure of the ovarian pedicle.[7]

Mammary Gland Tumors

An important time-dependent benefit of elective sterilization in female dogs is a decreased incidence of mammary gland tumors. Mammary gland tumors are the most common tumors in female dogs, with an overall incidence of 3.4%; 41% to 53% of mammary gland tumors are reportedly malignant, and metastasis is common.[21–24] The relative risk for malignant mammary gland tumor development in dogs sterilized before the first estrus is 0.5%, compared with the risk in sexually intact dogs. Dogs sterilized between the first and second estrus have a relative risk of 8%, and dogs sterilized between the second and third estrus have a relative risk of 26%.[22] There is no documented beneficial effect of sterilization on development of malignant mammary gland tumors after the third estrus. The development of mammary gland tumors in dogs appears to be hormone dependent, although an exact cause-and-effect relationship between neuter status and mammary gland neoplasia has not been identified.[21] Sterilization by either ovariohysterectomy or ovariectomy in a time-dependent fashion can largely eliminate the risk that mammary gland tumors will develop in dogs.

Uterine Abnormalities

Ovariohysterectomy, rather than ovariectomy, is often advocated for female dogs and cats because of the presumed potential for uterine abnormalities to develop in animals in which the uterus is not removed. The most commonly cited abnormalities in this regard include cystic endometrial hyperplasia (CEH)–pyometra complex and uterine neoplasia.

CEH-pyometra complex—Cystic endometrial hyperplasia–pyometra complex is a condition that occurs secondary to chronic hormone influence on the uterus.[25,26] The exact pathophysiology of CEH-pyometra complex is not completely understood, but current theory suggests that progesterone priming of uterine tissue leads to a suppressed immune system, closure of the cervix, stimulation of endometrial secretions, and development of CEH. Cystic endometrial hyperplasia allows ascending opportunistic pathogens (most frequently *Escherichia coli*) to cause infection and pyometra.[25,26] All dogs with an intact uterus are expected to develop CEH with age, but not all dogs with CEH will go on to develop pyometra.

Regardless of the exact pathophysiology of the CEH-pyometra complex, it is clear that it requires a source of progesterone, so it is not expected to occur after complete removal of the ovaries. In a previous study,[27] a questionnaire was administered to the owners of 135 dogs (69 that had undergone ovariectomy and 66 that had undergone ovariohysterectomy) eight

to 11 years after surgery, and none of the dogs had developed signs of CEH-pyometra complex. In another study,[28] bilateral flank ovariectomy was performed in 72 dogs, and no episodes of pyometra were identified after six to 10 years of follow-up. Potentially, pyometra could occur after ovariectomy if exogenous progesterones are administered, but there are currently no diseases for which the use of these substances is recommended. Stump pyometra, often cited as an example of how pyometra can occur in the absence of the ovaries, has only been reported in association with ORS, breakage in aseptic technique, or exogenous progesterone administration.[7,29–31]

Uterine neoplasia—Primary uterine tumors in dogs are rare, and almost all are benign leiomyomas.[32–36] In a survey of the incidence of neoplasia in dogs, only 11 of 33,570 female dogs had a tumor of the uterus and only one had a malignant uterine tumor.[32] Another study[35] identified nine dogs with uterine or cervical tumors among 2,361 dogs with neoplasia. Finally, postmortem histologic evaluation of the genital tracts of 300 mixed-breed female dogs identified a single primary uterine tumor.[33] On the basis of results of these studies, it has been calculated that the true overall incidence of malignant uterine neoplasia in dogs is approximately 0.003%.[7] Leiomyomas of the uterus are generally regarded as noninvasive, nonmetastatic, and slow growing, with hysterectomy almost always curative.

To our knowledge, uterine neoplasia has never been reported in a dog that has had its ovaries removed before 2 years of age, regardless of whether the uterus was left in situ. This would suggest a strong hormonal influence on the development of these tumors and a sparing effect of any technique that removes the ovaries.[32,34,35]

Urinary Sphincter Mechanism Incontinence

Urinary sphincter mechanism incontinence (USMI) reportedly occurs in 4.9% to 20.0% of sterilized female dogs, compared with 0.2% to 1.0% of sexually intact female dogs.[7,21,37–39] Large-breed and giant-breed dogs and dogs that undergo gonadectomy at an earlier age appear to have a higher risk of developing USMI. In a retrospective study[40] evaluating the long-term effects of gonadectomy at an early age, dogs were significantly more likely to develop USMI if spayed before 3 months of age. The corresponding projected cumulative incidence during the first 6 years of age (when most signs of incontinence are identified) was 12.9% for female dogs spayed before 3 months of age and 5.0% for female dogs spayed at or after 3 months of age.[40]

Although the underlying mechanism of USMI is poorly understood, the importance of estrogen influence is not debated. Therefore, the incidence of USMI should not differ regardless of whether the uterus is removed. In one study,[27] six of 69 (8.7%) dogs developed USMI after ovariectomy, compared with nine of 66 (13.6%) after ovariohysterectomy. In other studies,[7,38] 54 of 260 (20.8%) dogs undergoing ovariectomy and 29 of 152 (19.1%) dogs undergoing ovariohysterectomy developed USMI after surgery.

Conclusion

We do not believe that there is any scientific evidence for the preferential teaching of ovariohysterectomy instead of ovariectomy by schools and colleges of veterinary medicine in the United States and Canada, and it is our view that ovariectomy provides an equally effective technique for elective sterilization of female dogs and cats, with no recognized disadvantages. Potential advantages of ovariectomy include a smaller incision, better viewing of the ovarian pedicle, and possibly less risk of complications associated with surgical manipulation of the uterus.

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