A MATTER OF OPINION

AGE OF NEUTERING IN LARGE- & GIANT-BREED DOGS

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In the United States, gonadectomy is routinely performed in dogs between 4 and 9 months of age.[1-3] The decision to perform this procedure is often based on convention, habit, or misconception of health benefits rather than on an evidence-based assessment of each patient.

Following is a discussion of the benefits and potential adverse events of gonadectomy in large- and giant-breed dogs (***Table 1***). Of note, much of the literature on this topic is retrospective and based on smaller select populations, so relative risk is difficult to determine for individual animals.

General Considerations

Ovariohysterectomy (OHE) prevents pyometra but may increase risk for uri-

TABLE 1

EFFECTS OF GONADECTOMY ON RELATIVE RISK

Condition	Effect of OHE on Relative Risk	Effect of Castration on Relative Risk
Overall longevity	Mild increase in longevity	Mild increase in longevity
Obesity	Moderate increase	Moderate increase
Cranial cruciate ligament disease	Moderate increase*	Moderate increase*
Hip dysplasia	Mild increase*	Mild increase*
Mammary tumors	Marked decrease*	N/A
Uterine, ovarian, vaginal tumors	Prevents	N/A
Testicular tumors	N/A	Prevents
Perianal gland tumors	N/A	Marked decrease
Prostatic carcinoma	N/A	Mild increase
Lymphoma	Mild increase	Mild increase*
Mast cell tumors	Mild increase	N/A
Hemangiosarcoma	Mild increase*	Mild increase
Osteosarcoma	Mild increase*	Mild increase*
Transitional cell carcinoma	Mild increase	Mild increase
Urinary sphincter mechanism incompetence	Moderate increase*	N/A
Cystitis	Mild increase*	N/A
Benign prostatic hyperplasia	N/A	Marked decrease
Perineal hernia	N/A	Moderate decrease

*Age at time of surgery may be important.

nary sphincter mechanism incompetence (USMI). In general, large dogs (>15 kg) have a significantly greater risk for developing USMI than smaller dogs.[4,5]

Although dogs that have OHE before 3 months of age show an increased risk for USMI as compared with dogs that have OHE between 3 and 12 months of age,[6] other data and analyses have not supported a causal link between age at time of OHE and risk for USMI.[4,5,7,8]

Prepubescent OHE can result in a recessed or hypoplastic vulva in some dogs and may predispose these animals to perivulvar dermatitis and cystitis, particularly if they are overweight and have USMI. These findings may explain the greater reported incidence of cystitis in dogs undergoing OHE before 5.5 months of age.[6]

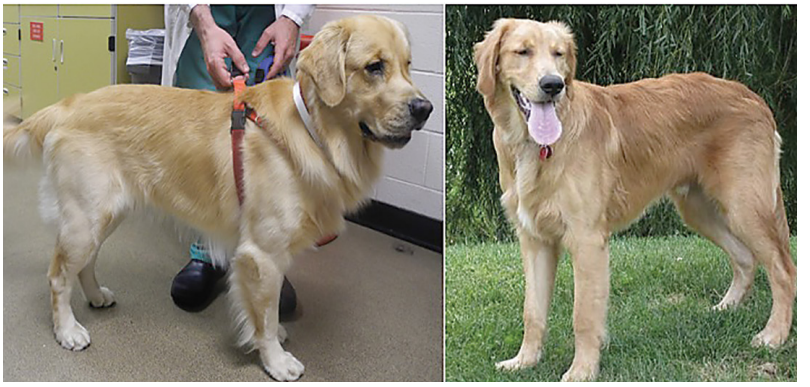
Benign prostatic hyperplasia is seen in 50% of intact males by 5 years of age.[9] Castration prevents benign prostatic hyperplasia as well as other associated diseases (eg, prostatitis, prostatic cysts, perineal herniation).[10-12]

Musculoskeletal Considerations

Removing hormonal influence on the developing skeleton via gonadectomy can result in delayed physeal closure[13,14] and longer-limbed conformation (***Figure 1***). The latter may play a role in the development of orthopedic disease, as shown in Labrador and golden retrievers neutered <6 months of age. These dogs had a 2× to 5× increased incidence of ≥1 joint disorders as compared with intact dogs.[15,16]

Canine Cranial Cruciate Ligament Disease

Large-breed dogs that underwent gonadectomy at <6 months of age have shown a 3× increased risk for excessive tibial plateau angle and predisposition for earlier canine cranial cruciate ligament (CCL) injury.[17] Dogs that underwent gonadectomy at a nonspecified age had a 2× to 3× incidence of CCL disease as compared with intact dogs.[18,19] In a study of 750 golden retrievers, none of the intact dogs had CCL disease, compared with an incidence of 5% in castrated dogs and 7.7% in spayed dogs that underwent gonadectomy at <12 months of age.[16] BCS was the same for dogs with and without CCL disease. This suggests that change in conformation—not just increased body weight associated with gonadectomy—was responsible.[16]



▲ **FIGURE 1** Body conformation. Both golden retrievers are adult males of similar age. The dog on the left is intact, and the dog on the right was neutered at 5 months of age. Resultant delayed physeal closure can lead to a longer-limbed conformation.

Hip Dysplasia

Hip dysplasia may be influenced by patient sex and breed and timing of gonadectomy. In the golden retriever study,[16] incidence of hip dysplasia in males neutered at <12 months of age was double that of intact males, with an earlier onset of disease. The BCS of the males with and without hip dysplasia and neutered at <12 months of age was not far greater. No significant difference in hip dysplasia incidence was seen in the females.[16]

BCS = body condition score
CCL = cranial cruciate ligament
OHE = ovariohysterectomy
USMI = urinary sphincter mechanism incompetence

Spayed or neutered boxers with a mean age of 3 years at the time of gonadectomy had a 1.5× increased risk for developing hip dysplasia.[20] Data collected from the Veterinary Medical Database between 1964 and 2003 showed that gonadectomy (at a nonspecified age) increased the likelihood of hip dysplasia by 17%.[18] Incidence of hip dysplasia was 6.7% in dogs that underwent gonadectomy before 5.5 months of age and 4.7% in dogs that underwent gonadectomy between 5.5 months and 1 year of age.[6]

Obesity

Obesity plays a significant role in the development and progression of many orthopedic diseases and osteoarthritis.[21] Although gonadectomy is a significant risk factor for obesity,[6,22,23] gonadectomy alone is most likely less important than other environmental factors (eg, diet, exercise regimen).[24]

Oncologic Considerations

Mammary Tumors

Many veterinarians are aware of the effect and timing of spaying on incidence of mammary tumors (***Table 2***) based on Schneider, Dorn, and Taylor's 1969 study.[25]

Spaying after the third estrous cycle and after 2.5 years of age appears to provide minimal protection against mammary tumor development.[25,26] A 2010 systematic review of this and other studies on the protective effect of OHE concluded that the evidence is weak because of confounding factors and bias.[27] Incidence of mammary tumors in intact females, however, increases with age and exposure to sex hormones, with increasing tumor risk between 7 and 13 years of age.[28-30]

OHE = ovariohysterectomy

TABLE 2

REPRODUCTIVE STATUS & MAMMARY TUMOR RISK

Reproductive Status at Time of OHE	Mammary Tumor Risk
Never in estrus	0.5%
In estrus 1 time only	8%
In estrus ≥2 times , regardless of age	26%
and ≤2.5 years of age	6%
and >2.5 years of age	40%

Reproductive Tumors & Tumors Influenced by Hormones

Gonadectomy eliminates the potential for developing uterine, ovarian, and testicular tumors through removal of the primary organ.[31] Perianal gland tumors in male dogs are treated successfully via castration.[32] OHE is protective against vaginal leiomyomas and can decrease recurrence, even with incomplete surgical resection.[33,34] Neutered male dogs had 2× to 8× the incidence of prostatic carcinoma as compared with intact male dogs[34,35]; however, the overall prevalence of prostatic cancer is <1%.[35-37]

Lymphoma

A large population study showed that intact female dogs had a significantly lower risk for developing lymphoma as compared with dogs that underwent gonadectomy (at a nonspecific age) or intact male dogs.[38] This finding was consistent in studies of golden retrievers and vizslas, although castration at <12 months of age was also found to be a risk factor.[16,39]

Mast Cell Tumors

Gonadectomy has been associated with 2× to 4× the risk for mast cell tumors,

particularly in female dogs that underwent OHE after 1 year of age.[16,39,40] However, estrogen receptors have not been identified in mast cell tumors, so a direct hormonal link has not been established.[41]

Hemangiosarcoma

Golden retrievers that underwent OHE after 1 year of age had 4× the incidence of hemangiosarcoma as compared with intact females or females that underwent OHE before 1 year of age.[16] No significant differences in incidence of hemangiosarcoma were found in male golden retrievers.[16] Similar findings were noted in a study of vizslas, although dogs that underwent OHE before 1 year of age or castration after 1 year of age also had increased risk.[39] Other non-breed-specific studies have shown similar findings for splenic and cardiac hemangiosarcoma.[42,43]

Osteosarcoma

An increased risk for osteosarcoma was seen in rottweilers that underwent OHE or castration before 1 year of age, although the overall 13% incidence of bone sarcoma in this study group seems disproportionately high.[44] Historic studies have reported a 1.3× to 1.9× increased risk for osteosarcoma in animals that underwent gonadectomy at a nonspecified age.[45,46]

Transitional Cell Carcinoma

Female dogs are more predisposed to bladder transitional cell carcinoma than are male dogs, and gonadectomy (at a nonspecified age) increases the risk up to 3× in both male and female dogs.[47,48] An 8× increase in prostatic transitional cell carcinoma has also been reported in male dogs that underwent castration at a nonspecified age.[36]

In My Opinion …

Existing studies on the benefits and detriments of performing gonadectomy in large- and giant-breed dogs <12 months of age provide conflicting data, and most literature is retrospective. In addition, because pet longevity is increased with gonadectomy,[31,49] the risk for developing cancer may be higher. On their completion, comprehensive prospective studies such as the Lifetime Golden Retriever study[50] could provide clearer guidelines on when to perform OHE and castration.

For large- and giant-breed dogs, this author generally recommends OHE between the first and second estrous cycles in female dogs and castration after musculoskeletal maturity in male dogs. Although timing of gonadectomy may play a role in the development of certain diseases, patient genetics and environmental factors are likely to be equally, if not more, important.

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