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Effects of ovariohysterectomy on reactivity in German Shepherd dogs

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Abstract

This study investigated the effects of ovariohysterectomy on reactivity of German Shepherd dogs. Fourteen healthy dogs ranging in age from 5 to 10 months were assigned to an ovariohysterectomy or a sexually intact group. Their behaviours were digitally video recorded 4–5 months after treatment and analysed for treatment effects on reactivity. Responses to the approach of an unfamiliar human leading an unknown dog were assigned the following reactivity scores: severe reactivity, 3; moderate reactivity, 2; defensive or mild reactivity, 1; attentive or no reactivity, 0. Median reactivity scores in response to the approach of an unfamiliar human walking with an unknown dog were calculated for each observation period.

Dogs in the ovariohysterectomized group showed more reactivity, and median reactivity scores were higher in the ovariohysterectomy group compared with those of the sexually intact group. Ovariohysterectomy of 5–10 month old German Shepherd bitches specifically, and perhaps bitches of any breed generally, may induce an increase in reactivity. Practitioners may benefit from recognizing that a range of behavioural changes may occur post-ovariohysterectomy.

Keywords: Aggression; Behaviour; Dog; Ovariohysterectomy; Reactivity

1. Introduction

Ovariohysterectomy is one of the most frequently performed surgical operations in dogs. The usual recommendation is to perform the surgery when a bitch is between 5 and 8 months old and after the first oestrus (Jackson, 1984; Johnston, 1993; Salmeri et al., 1991; Stone et al., 1993).

The most common reason for performing an ovariohysterectomy is to prevent unwanted pregnancy (Salmeri et al., 1991) but other reasons include prevention and treatment of pyometra, metritis, neoplasia, cysts, trauma, uterine torsion and subinvolution of placental sites (Cotchin, 1961; Dow, 1958; Durfee, 1968; Fidler et al., 1966; Fingland, 1998; Hedlund, 2002; Jergens et al., 1987; Sandholm et al., 1975; Stone et al., 1993). Although ovariohysterectomy has been performed for many of the reasons given above, the side effects of the operation, particularly any changes in behaviour, have been quantified in only few studies (Hardie et al., 1997; O' Farrell and Peachey, 1990).

Houpt et al. (1979) reported that ovariohysterectomized bitches gained more weight than sham-operated controls and food intake also was significantly greater. On the basis of a survey of owners, O' Farrell and Peachey (1990) noted that spaying was accompanied by a risk of increased indiscriminate appetite and by aggression towards family members but only if the puppies already exhibited some aggression at less than one year

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of age. Salmeri et al. (1991) found that ovariohysterectomized bitches showed more general activity than a sexually intact group, and Thrusfield (1985) reported that urinary incontinence occasionally followed ovariohysterectomy.

A dog's 'reactivity' can be inferred by visual signals, from the ears, mouth, facial expression, tail, the hair on shoulders and rump, overall body position and posture (Abrantes, 1997; Beaver, 1999; Houpt, 1998; Landsberg et al., 2003; Overall, 1997; Schaffer, 1993; Voith and Borchelt, 1996). In order to investigate behavioural changes after ovariohysterectomy we exposed the dogs in the present study to a strong social stimulus: a stranger and a strange dog approaching the front of the dog's kennel. We observed the dogs' behaviour, and the visual, auditory signals shown. On the basis of these observations, we evaluated the effects of ovariohysterectomy on canine behaviour.

2. Materials and methods

2.1. Experimental animals

Fourteen healthy German Shepherd (GSD) bitches at the Korean Air Force Dog Training Center were studied. Their ages were between 5 and 10 months (mean ± SD, 6.5 ± 1.8) at the time of surgery and between 10 and 15 months at the time of behavioural testing. Dogs were housed in 180 × 240 cm wire mesh kennels with 250 cm walls. Each kennel contained a 180 × 60 × 140 cm dog house.

The animals were handled according to the Laboratory Animal Control Guidelines of Gyeongsang National University, which are based on the *Guide for the Care and Use of Laboratory Animals* of the US National Institutes of Health (1996).

2.2. Experimental design and surgery protocol

The dogs were assigned randomly to either the ovariohysterectomy (OVH) or to the sexually intact group (SIG).

OVH dogs were premedicated with glycopyrrolate (0.01 mg/kg, IM), acepromazine (0.02–0.05 mg/kg, IM), butorphanol (0.02–0.04 mg/kg, IM) or oxymorphone (0.05 mg/kg, IM). General anaesthesia was induced by administration of thiopental sodium (10–12 mg/kg, IV) and anaesthesia was maintained with isoflurane (1–2.5%) during OVH (surgery group). SIG dogs were anaesthetized as above and then allowed to recover from the anaesthesia.

During the first 18–24 h after surgery, IM injections of either oxymorphone (0.05 mg/kg) or butorphanol (0.02–0.04 mg/kg) were administered every 6 h for management of pain. To control for genetic and early environmental influences, littermates were assigned equally to both groups.

The responses of the bitches to the approach of a unfamiliar human with a dog unknown to the test dog to within 1 m of the dog's kennel were recorded using a Digital Palmcorder four and five months after surgery when the dogs were 10–15 months old. The 14 dogs were observed twice one week apart at 4 months and twice one week apart at 5 months making a total of 56 observations. Only the focal dog remained in a run; the other dogs were confined indoors.

The unfamiliar human and dog stood in front of the kennel and the observations ended when the dog calmed down. Behaviours were analysed for 2–3 min during each observation.

2.3. Behaviour analysis

A single observer performed all analyses of the videos.

Parameters observed were ear, eye and lip-positions, tooth exposure and posture. Any vocalization was also recorded.

On the basis of previous descriptions (Abrantes, 1997; Beaver, 1999; Houpt, 1998; Landsberg et al., 2003; Overall, 1997; Reisner, 2003; Schaffer, 1993; Voith and Borchelt, 1996), all behaviour used for analysis was scored by an observer blind to the dog's reproductive condition. Individual reactivity scores in response to the approach of a stranger with a strange dog (the stimulus to reactivity) were determined, and a median reactivity score was calculated for each observation time (Table 1).

If a dog reacted with barking and growling, snarling, lips lifting or curling, head up, ears forward, staring, widely opened eyes and was lunging and jumping it was given a score of 3 (Fig. 1). Ifone to three of these actions were not exhibited the dog was given a score of 2 (Fig. 2). If four or more were not exhibited the dog was given a score of 1 (Fig. 3). If the dog did not respond at all it received a 0 score (Fig. 4).

Table 1
Evaluation and grading of reactivity

Grade	Description of body expression and vocalization
3	Vocalization: bark or growling, movement: lunging or jumping, snapping, head: up, ear: forward, eye: large palpebral fissure staring, lip: lifting or curling
2	Body expression and vocalization were changed by ⩽3 items, being compared with grade 3
1	Body expression and vocalization were changed by ⩾4 items, being compared with grade 3
0	No response or attentive

Fig. 1. The posture of grade 3 reactivity. Dog barks and shows growling, jumping, snapping, head up, ear forward, large palpebral fissure staring and lip curling.

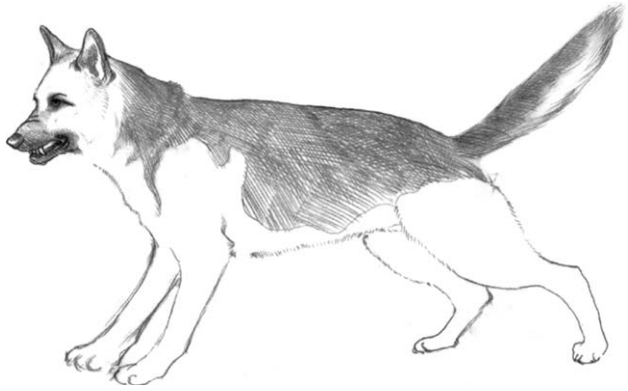

Fig. 2. The posture of grade 2 reactivity. Dog shows growling, snapping, ears forward, large palpebral fissure, staring, lip curling and tail up.

2.4. Statistical analysis

The behavioural effect of OVH was evaluated by comparing the scores of the two groups. The non-parametric repeated measures analysis of variance and Mann–Whitney *U*-test were used for comparisons between the OVH and sexually intact groups. Wilcoxon matched-pairs signed-ranks test was used to make comparison within groups between the observation times. All statistical tests were performed by use of computer software SPSS 9.

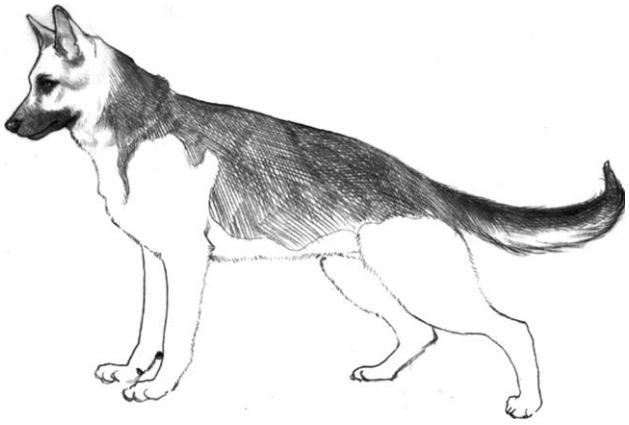

Fig. 3. The posture of grade 1 reactivity. Dog shows ears forward, large palpebral fissure staring and tail swing.

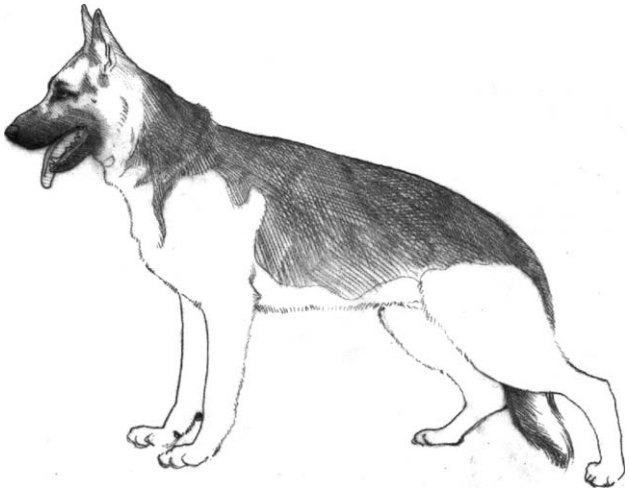

Fig. 4. The posture of grade 0 reactivity. Dog shows ears forward and a relaxed tail.

3. Results

Dogs in the OVH group showed increased reactivity based on facial expression and activities. Median reactivity scores were higher in the OVH group compared to those of the sexually intact group ($P < 0.05$) (Table 2). Median reactivity scores of the OVH group decreased significantly from 3 during the first observation to 1.1 during the fourth observation ($P < 0.001$). Median reactivity scores of the SIG group decreased from 1 at first observation time to 0.4 during the fourth observation ($P = 0.218$).

Of the 56 observations (4×14 dogs), head up was observed 43 times – 25 OVH and 18 SIG. The ears were forward 32 times – 25 OVH and 7 SIG. Staring with widely opened eyes was observed 22 times but only in the OVH group. The commissures of the lips were drawn forward 17 times and all in the OVH group.

Table 2
Individual reactivity scores in response to the approach of a stranger with a strange dog (the stimulus to reactivity)

Observation time	Group													
	OVH ($n = 7$)							SIG ($n = 7$)						
Dog ID:	A	B	C	D	E	F	G	H	I	J	K	L	M	N
4th month														
1st week	3	3	2	2	2	2	1	1	1	1	1	1	1	0
2nd week	3	3	2	2	2	2	1	1	1	1	1	1	1	0
5th month														
1st week	3	3	2	2	2	1	1	1	1	1	1	1	1	0
2nd week	3	2	2	2	2	1	1	1	1	1	1	1	1	0

Note: OVH, ovariohysterectomy group; SIG, sexually intact group.

Table 3
Items and frequencies of observed behaviours

Items	Behaviour	SIG	OVH	Items	Behaviour	SIG	OVH
Head	Up	18	25	Tail	High, wagging rapidly	5	3
	Down	10	0		High, wagging slowly	2	3
Ears	Forward	7	25		Horizontal, wagging rapidly	3	12
	Flanked	16	0		Horizontal, wagging slowly	3	10
	Flattened	5	3		Down	8	0
Eyes	Big, staring	0	22		Down, wagging rapidly	2	0
	Averted	7	3		Down, wagging slowly	5	0
	Moved	11	0	Posture	Shifted to front	6	25
	In nature	10	3		Shifted to middle	16	3
					Shifted back	6	0
Lips	Drawn forward	0	17	Vocalization (sum of call numbers)	Bark	311	1314
	Drawn back	10	6		Bark and growl		105
	In nature	18	5		Bark and whine	533	
Movements	Jump	5	5		Bark, growl, and whine		45
	Lunge	0	2	Teeth	No	19	5
	Jump and lunge	0	10		Incisor	0	6
	Retreat	8	0		Canine	1	9
	Sit	2	0		Premolar	7	7
	Circle	2	0		Molar	1	1
	Come and go	10	10				
	No movement	1	1				

Note: SIG, sexually intact group; OVH, ovariohysterectomy group.

Raised and a rapidly wagged tail was observed 8 times, 3 OVH and 5 SIG. A neutral posture – leaning neither forwards nor backwards was observed 19 times, 3 OVH and 16 SIG. Leaning back was observed 6 times, all by SIG (Table 3).

4. Discussion

The study was carried out to investigate the effects of OVH on reactivity in German Shepherd bitches 4 and 5 months after surgery. The results revealed that reactivity was increased in the OVH dogs in comparison to the intact group. It is unlikely that post-operative pain or side effects of analgesics was responsible for any of the increased reactivity due to the time that had elapsed since surgery.

Although this is the first prospective study of the effects of spaying on reactivity, there have been two retrospective studies indicating an increase in reactivity after surgery. The risk of post OVH reactivity is higher if the bitches had already exhibited reactivity before their first birthday (O' Farrell and Peachey, 1990). A recent study indicated no difference in aggressiveness between bitches ovariohysterectomized before or after they had reached 5.5 months of age (Spain et al., 2004). Other less serious changes after OVH include an increase in activity and an increase in food intake, which, combined with a decreased metabolic rate, leads to an increase in body weight and urinary incontinence (which may be due to oestrogen deficiency or to adhesions or granulomas of the stump that interfere with the bladder sphincter mechanism) (Hardie et al., 1997; Houpt et al., 1979; Kyles et al., 1996; Salmeri et al., 1991).

In the present study, overall body expression and specific facial expressions were used to determine the level of reactivity. More spayed bitches than intact bitches exhibited wide open staring eyes. These results are similar to broad findings cited for self-confident or offensively aggressive dogs (Abrantes, 1997; Beaver, 1999; Houpt, 1998; Landsberg et al., 2003; Overall, 1997; Reisner, 2003; Schaffer, 1993; Voith and Borchelt, 1996). In our study, we found that more of spayed than intact GSD bitches had erect ears, although the erect ear could be simply an expression of an attentive or solicitous dog.

In previous descriptions (Abrantes, 1997; Beaver, 1999; Houpt, 1998; Landsberg et al., 2003; Overall, 1997; Reisner, 2003; Schaffer, 1993; Voith and Borchelt, 1996), shifting weight to the front was considered to be offensively aggressive, shifting the weight back to be withdrawal due to fear. Although shifting weight to the front feet could be ambivalent, we considered it as offensive reactivity if the dog showed other offensive behaviour.

Lifted lips were considered to be reactivity and relaxed lips as non-reactivity. If the commissures of the lips were drawn forward the dog was considered to be offensively reactive, but if they were drawn back she was considered to be defensively reactive. Based on overall body expression, OVH bitches showed more offensive reactivity than sexually intact dogs. Median scores decreased during the two months of observation time. The dogs probably had habituated to the stimuli eliciting behaviour.

Dogs communicate with various signals as human do. Common visual communication signals of dogs are ear-position, lip-position, facial expression, tail carriage, piloerection and overall body posture. These communications are different according to the dog's interpretation of and response to those of other individual in the environment. Relaxed dogs will show ears and tail that are down and will stand in a relaxed posture, but reactive dogs show erect ears, head and tail up and staring eyes. In this study, we observed head posture, eyes and ear position with the overall body posture. The results indicated that the postures of the dogs in OVH group presented with more offensive reactivity than those of the sexually intact group. Because the German Shepherd breed in general, and these military dogs in particular, have been selected for aggression and guard work, studies should be undertaken to measure the effect of ovariohysterectomy on the behaviour of bitches of other breeds.

Reactivity was induced by the approach of a stranger with a strange dog to the front of the study animal's own kennel, and dogs ovariohysterectomized between 5 and 10 months of age exhibited an increase in intensity of reactivity as measured by visual signals. Whether either earlier or post pubertal OVH would have had similar effects is unknown, but veterinary practitioners should inform owners that a bitch may become more reactive after spaying either because they have lost the calming effects of progesterone or because elevated gonadotropins stimulate release of adrenal androgens.

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References

Abrantes, R., 1997. Dog Language: an Encyclopedia of Canine Behaviour. Wakan Tanke Publishers, Naperville, IL, USA, pp. 11–255.

Beaver, B.V., 1999. Canine Behavior: a Guide for Veterinarians. WB Saunders Co., Philadelphia, PA, USA, pp. 106–199.

Cotchin, E., 1961. Canine ovarian neoplasm. Research in Veterinary Science 2, 133–142.

Dow, C., 1958. The cystic hyperplasia–pyometra complex in the bitch. Veterinary Record 70, 1102–1110.

Durfee, P.T., 1968. Surgical treatment of postparturient metritis in the bitch. Journal of the American Veterinary Medical Association 153, 40–42.

Fidler, I.J., Brodey, R.S., Howson, A.E., Cohen, D., 1966. Relationship of estrus irregularity, pseudopregnancy, and pregnancy to canine pyometra. Journal of the American Veterinary Medical Association 149, 1043–1046.

Fingland, R.B., 1998. Ovariohysterectomy. In: Bojrab, M.J., Ellison, G.W., Slocum, B. (Eds.), Current Techniques in Small Animal Surgery, fourth ed. Williams & Wilkins Co., Baltimore, USA.

Hardie, E.M., Hansen, B.D., Carroll, G.S., 1997. Behavior after ovariohysterectomy in the dog: what's normal. Applied Animal Behaviour Science 51, 111–128.

Hedlund, C.S., 2002. Surgery of the reproductive and genital systems. In: Fossum, TW (Ed.), Small Animal Surgery, 2nd ed. Mosby Inc., St. Louis, MI, USA, pp. 616–618.

Houpt, K.A., 1998. Domestic Animal Behavior for Veterinarians and Animal Scientist, 3rd ed. Iowa State University Press, Ames Iowa, USA, pp. 3–81.

Houpt, K.A., Coren, B., Hintz, H.F., Hilderbrant, J.E., 1979. Effect of sex and reproductive status on sucrose preference, food intake, and body weight of dogs. Journal of the American Veterinary Medical Association 174, 1083–1085.

Jackson, E.K., 1984. Contraception in the dog and cat. British Veterinary Journal 140, 132–137.

Jergens, A.E., Knapp, D.W., Shaw, D.P., 1987. Ovarian teratoma in a bitch. Journal of the American Veterinary Medical Association 191, 81–83.

Johnston, L., 1993. Opposes early-age neutering (lett). Journal of the American Veterinary Medical Association 202, 1041–1042.

Kyles, A.E., Aronsohn, M., Stone, E.A., 1996. Ovariohysterectomy. In: Lipowitz, A.J., Cay wood, D.D., Newton, C.D., Schwartz, A. (Eds.), Complications in Small Animal Surgery. Williams & Wilkins, Philadelphia, PA, USA, pp. 496–503.

Landsberg, G., Hunthausen, W., Ackerman, L., 2003. Handbook of Behaviour Problems of the Dog and Cat, second ed. Saunders, Philadelphia, PA, USA, pp. 385–426.

O' Farrell, V., Peachey, E., 1990. Behavioural effects of ovariohysterectomy on bitches. Journal of Small Animal Practice 31, 595–598.

Overall, K.L., 1997. Clinical Behavioural Medicine for Small Animals. Mosby-Year Book Inc., St. Louis, MI, USA, pp. 88–137.

Reisner, I.R., 2003. Differential diagnosis and management of human-directed reactivity in dogs. Veterinary Clinics of North America: Small Animal Practitioner 33, 303–320.

Salmeri, K.R., Bloomberg, M.S., Scruggs, S.L., Shille, V., 1991. Gonadectomy in immature dogs: effects on skeletal, physical, and behavioural development. Journal of the American Veterinary Medical Association 198, 1193–1202.

Sandholm, M., Vasenius, H., Kivisto, A.-K., 1975. Pathogenesis of canine pyometra. Journal of the American Veterinary Medical Association 167, 1006–1010.

Schaffer, C.B., 1993. The Tuskegee Behavior Test for Selecting Therapy Dogs. Tuskegee University, Tuskegee, AL, USA.

Spain, C.V., Scarlett, J.M., Houpt, K.A., 2004. Long-term risks and benefits of early age gonadectomy in dogs. Journal of the American Veterinary Medical Association 224, 380–387.

Stone, E.A., Cantrell, C.G., Sharp, N.J.H., 1993. Ovary and uterus. In: Slatter, D. (Ed.), Textbook of Small Animal Surgery, second ed. WB Saunders Co., Philadelphia, PA, USA, pp. 1293–1308.

Thrusfield, M.V., 1985. Association between urinary incontinence and spaying in bitches. Veterinary Record 116, 695.

Voith, V.L., Borchelt, P.L., 1996. Readings in Companion Animal Behavior. Veterinary Learning System, Trenton, NJ, USA, pp. 230–239.