

Dr Amber Batson MRCVS ABTC

What a vet would like you
to know about
neutering.....

PDTE summit 2020



Neutering

Neutering remains the most common recommendation given to owners by vets and trainers when an un-neutered dog presents with any behavioural problem.

In many countries including the UK, much of Europe and USA, neutering remains the main method of population control and a strongly recommended procedure to prevent disease.

Recent studies have started to challenge whether neutering is really as beneficial for the individual as we would have owner's believe.

Neutering has been shown to reduce the incidence of certain diseases such as infections in the womb, prostate disease, some cancers etc

BUT neutering has been shown to increase the incidence of certain diseases such as osteoarthritis, ligament damage, some cancers, some immune mediated diseases etc

Neutering has been linked with improvements in mounting, urine spraying and roaming – all behaviours directly linked to sexual reproduction, but little or no effect on fear or aggression related behaviours (Neilson et al 1997)

Neutering has been linked in increases in certain behavioural reactivity issues including fear aggression

Neutering pre, peri or post puberty

Losing body parts is a big deal!

We are finally starting to understand that reproductive hormones produced by the gonads (ovaries and testes) have essential roles beyond achieving and maintaining pregnancy.

“Gonads are not merely gamete-producing or ancillary sex/reproductive organs but rather they are necessary endocrine glands for normal metabolic, behavioral, musculoskeletal, and anti-neoplastic health” From Kutzler 2020

If we remove body parts we definitely wont get disease in those body parts.

However, removing the gonads has quite a wide range of pros and cons on both disease and behaviour. It is a hugely emotive and conflicting topic which is only really now being fully appreciated.

The tables that follow in this presentation, are a rough guide to some of the main issues, see the references provided to learn more if you are interested.



Reproductive physiology changes at puberty

Male dogs

Low levels of testosterone are produced by the testes from birth.

Puberty marks the onset of a rise in testosterone by the testes into the blood, that results in the production of spermatozoa and the start of being able to fertilise female eggs.

Studies in free ranging, medium sized dogs have shown that testosterone levels and correspondingly, spermatozoa, are low before 24 weeks of age (approx. 5 months old) and no sperm were present in the testes. However, testosterone levels were increasing from approximately 20 weeks.

The pituitary gland starts producing LH (lutening hormone) from around 13 -20 weeks of age, and this peaks at around 36 weeks (or later in large/ giant breeds).

It takes a further 3-6 months for testicular tissue to be producing maximal androgen amounts and fertile sperm. At this time LH levels lower slightly then remain stable.

Beagles have been shown to have a significant plasma T rise with first ejaculate produced at 235 days of age (approx. 7 months) and Collies at 365 days.



Mounting and thrusting

NOT NECESSARILY INDICATIVE OF PUBERTY

*Play

Mounting (rearing up on hind legs and placing front legs over some part of another individual) and occasionally mounting then thrusting (moving the pelvis backwards and forwards) has been described as a normal part of play patterns seen in the dog. Often referred to as pseudosexual play.

This has been reported as early as 6 weeks of age.

Ref: Ward et al 2008 Partner preferences and asymmetries in social play

Pal 2010 Play behaviour during early ontogeny in free ranging dogs

*Displacement activity

Displacement activities are defined as those behaviours that are normal for that species but done out of appropriate context, undertaken at times of emotional or physical conflict or as the result of frustration.

Play has been described as a moderately common displacement activity in the dog. Mounting and thrusting therefore can indicate a negative emotional state for that dog rather than related directly to sexual activity.

Sommerville et al 2017 Why do dogs play?



Reproductive physiology changes at puberty

Female dogs

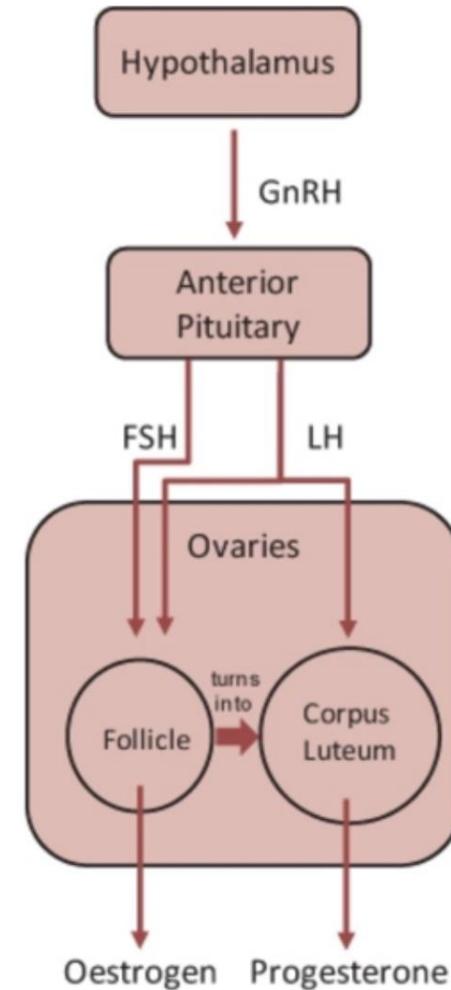
Female dogs are born in a state of ANOESTRUS

As they approach puberty the hypothalamus starts to send out pulses of GnRH (Gonadotrophin Releasing Hormone) which switches on the front part of the pituitary gland to start releasing FSH (Follicle Stimulating Hormone) and LH (Luteinising Hormone). These are released into the blood where they are detected by the 2 ovaries.

FSH stimulates the development of a number of follicles (which contain the eggs or oocytes) and LH stimulates the maturation of the follicle and then egg release, followed by the luteinisation process – the ruptured follicle region becoming a different tissue type called the CORPUS LUTEUM (CL).

When the follicles are developing, these release oestrogens.

When the follicles have ruptured and CLs have formed, the CLs produce progesterone.



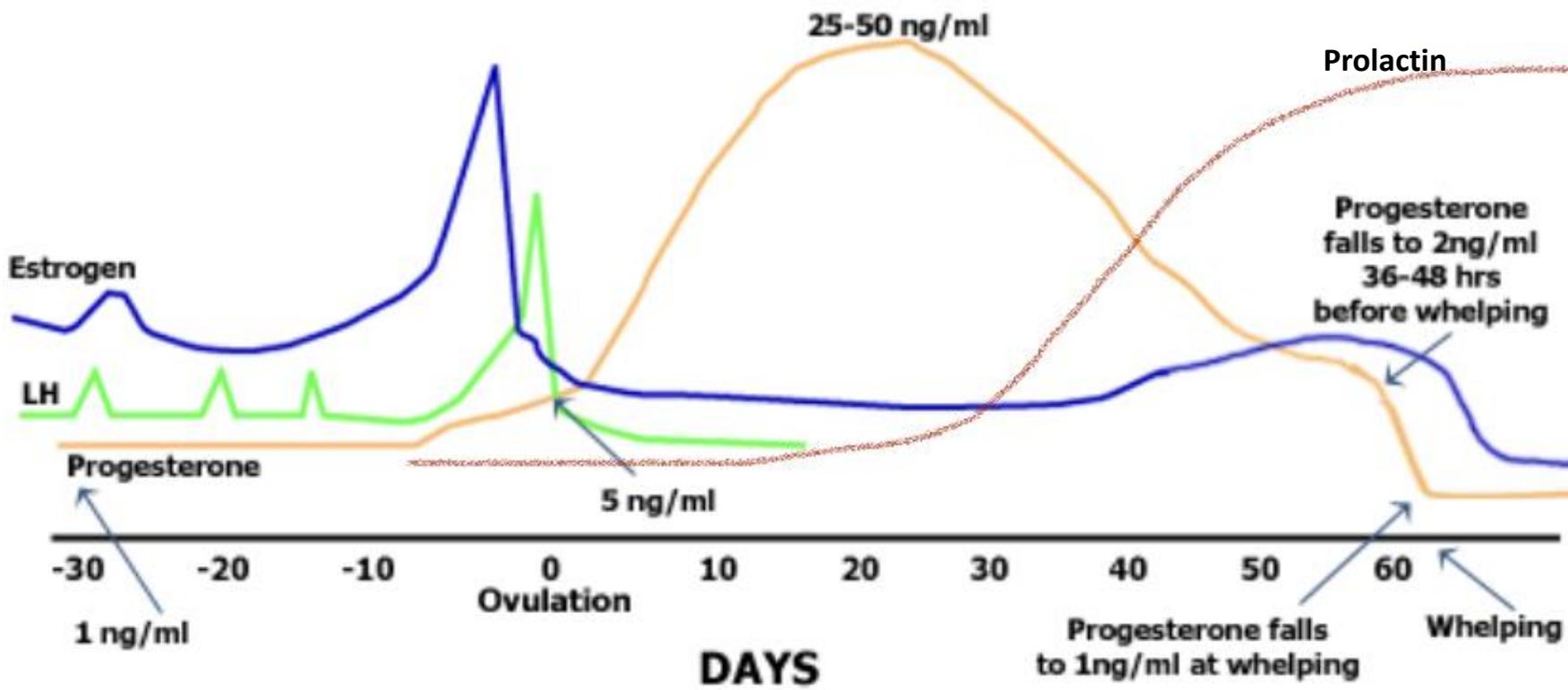


Image from wacvet.ca/services
modified to include prolactin

All cycling female dogs produce prolactin.
Unlike other species, if they are not pregnant they do not produce prostaglandin.
After ovulation, every female dog will go through a physiological pseudocyesis – a phantom pregnancy.



Reproductive physiology changes at puberty

Female dogs

Following the natural resolution of pseudocycsis (the result of a lack of oxytocin from puppies sucking on the breast causing the pituitary gland to stop releasing prolactin) which typically occurs around day 70-80 or the weaning of the puppies from a successful pregnancy causing the same reduction in prolactin, the female dog will reenter a period of anoestrus.

The next pulsing of GnRH will begin in 2- 4 months time in most female dogs, meaning that they on average have an ovulatory cycle twice per year.

The cycles are not related to the season of the year.



What is adolescence?

Adolescence is defined as “the transition from juvenile to adult and may be comprised of phases; early, middle and late, all of which encompass physical and psychological change”

Adolescence typically occurs during the teenage years in humans and includes puberty – the time when juveniles become capable of sexual reproduction. However, in humans it is now discussed that puberty may precede adolescence.

Puberty is a discrete physiological event driven by the maturation of the hypothalamic-pituitary-gonadal axis resulting in the ability to sire and care for offspring.

Adolescence is a developmental transition from dependence on caregivers to independence from caregivers.

Ref Romeo 2017 The metamorphosis of adolescent hormonal stress reactivity: a focus on animal models

When is adolescence?

“Domestic dog adolescence is frequently described as occurring between 6-9 months in male dogs and 6-16 months of age in females” as described by Pineda and Dooley 2015

Karen Overall, 2013 suggested that behavioural and social maturity occurs at 12-14 months.



Pros and cons of neutering

	Likely increase risk in small breeds	Likely decrease risk in small breeds	Likely increase risk in large breeds	Likely decrease risk in large breeds	
Population control	IT WORKS!	IT WORKS!	IT WORKS!	IT WORKS!	
Increased chance of future obesity	Yes	No	Yes	No	
Mammary cancer	No	Yes*	No	Yes*	*If neutered before second season. Maybe



Mammary tumour/cancer (MC) references

No cases of MC were diagnosed in intact females in this study.

This finding is partially explained by the relatively low frequency in which MC is diagnosed in Golden Retrievers. While this finding contrasts with the general concern expressed about the risk of MC in gonadally intact females, it is consistent with the recent findings from a systematic meta-analysis finding a weak link, if any, between neutering and reduced risk of MC.

From Torres De La Riva et al 2013

CONTROVERSIAL??

One study found an association between neutering and a reduced risk of mammary tumours. Two studies found no evidence of an association. One reported “some protective effect” of neutering on the risk of mammary tumours, but no numbers were presented. Due to the limited evidence available and the risk of bias in the published results, the evidence that neutering reduces the risk of mammary neoplasia, and the evidence that age at neutering has an effect, are judged to be weak and are not a sound basis for firm recommendations.

Beauvais W, Cardwell JM, Brodbelt DC (2012) The effect of neutering on the risk of mammary tumours in dogs – a systematic review. J Small Anim Pract 53: 314–322.



Pros and cons of neutering

	Likely increase risk in small breeds	Likely decrease risk in small breeds	Likely increase risk in large breeds	Likely decrease risk in large breeds	
Population control	IT WORKS!	IT WORKS!	IT WORKS!	IT WORKS!	
Increased chance of future obesity	Yes	No	Yes	No	
Mammary cancer	No	Yes*	No	Yes*	*If neutered before second season. Maybe
Womb infection (pyometra)	No	Yes	No	Yes	
Prostate disease	No	Yes	No	Yes	
Risk of arthritis	No	No	Yes	No	



	Likely increase risk in small breeds	Likely decrease risk in small breeds	Likely increase risk in large breeds	Likely decrease risk in large breeds	
Phantom pregnancy	No	Yes*	No	Yes*	*If neutered during a period of low prolactin
Behaviour changes associated with reproduction (roaming / urine marking / frustration aggression)	No	Yes*	No	Yes*	*Most likely if neutered pre puberty
Negative behaviour changes as the result of sex hormone loss (eg increased fear, increased risk cognitive decline)	Yes	No	Yes	No	
Urethral sphincter incompetence (post spay incontinence)	Maybe	No	Yes	No	Risk highest in >25kg dogs as adult, vulnerable breeds & if spayed <1 y o



	Likely increase risk in small breeds	Likely decrease risk in small breeds	Likely increase risk in large breeds	Likely decrease risk in large breeds	
Cranial cruciate rupture	No	No	Yes	No	Risk highest in >25kg dogs as adult, vulnerable breeds & if spayed <1 y o
Transitional cell carcinoma (bladder)	Yes	No	Yes	No	Rare cancer but highly metastatic Certain predisposed breeds should be neutered with caution
Bone cancer (osteosarcoma)	No	No	Yes	No	
Haemangiosarcoma	Maybe	No	Yes	No	Risk highest in large breed dogs and if neutered >1 year
Lymphoma	No?	No	Yes	No	



	Likely increase risk in small breeds	Likely decrease risk in small breeds	Likely increase risk in large breeds	Likely decrease risk in large breeds	
Atopic dermatitis	Yes	No	Yes	No	
Autoimmune haemolytic anaemia	Yes	No	Yes	No	
Immune mediated thrombocytopaenia	Yes	No	Yes	No	
Hypothyroidism	No?	No	Yes	No	
Inflammatory bowel disease	Yes	No	Yes	No	
Post vaccination reactions	Yes	No	Yes	No	



What actually happens?

Male dogs

Surgical Castration:

Remove their testicles = loss of testosterone
= loss of tissue producing sperm, therefore infertility

Medical castration:

Use a drug that stops testosterone production = loss of testosterone
= loss of ability to produce sperm, temporarily infertile
(possible gonad damage = long term infertility)

Vasectomy:

Remove portion of vas deferens = stops sperm entering the ejaculate and therefore being able to leave the
testicles via penis (infertility)
= testicular tissue unaffected so testosterone levels remain normal



What actually happens?

Female dogs

Surgical Ovariohysterectomy:

Remove their ovaries and womb = loss of oestrogen and progesterone (and folliculin)
= loss of ovaries containing eggs, and womb = infertility

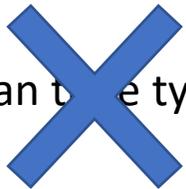
Surgical Ovariectomy:

Remove ovaries only = loss of oestrogen and progesterone (and folliculin)
= loss of ovaries containing eggs = infertility

Surgical hysterectomy:

Remove womb only = no loss of oestrogen / progesterone / folliculin
= loss of womb = infertility

Fallopian tube tying



= no loss of oestrogen / progesterone / folliculin
= eggs cannot find way into womb = infertility

Medical Neuter:

Use a drug that stops oestrogen production (progesterone) = loss of egg production = infertility

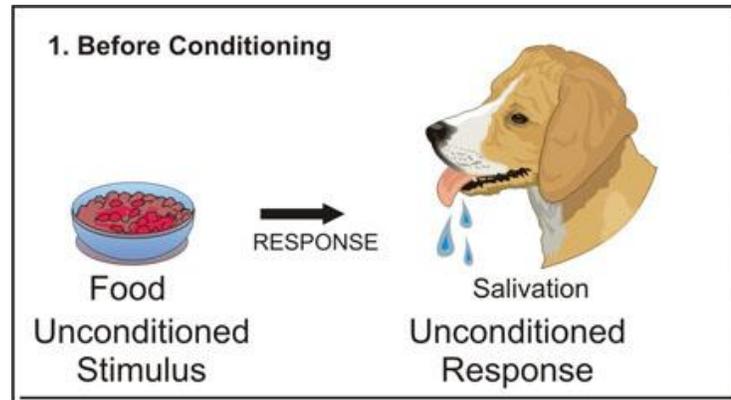


Neutering and behaviour

Fear and / or stress created by the neutering procedure

- **Being left in an unfamiliar place**
- **Pain and fear of handling prior to procedure**
- **Waking up disorientated after anaesthesia in an unknown place, often in some discomfort or pain**
- **Repeat trips to the surgery for post op checks and removal of stitches**

How the neutering experience may affect learning: Classical conditioning

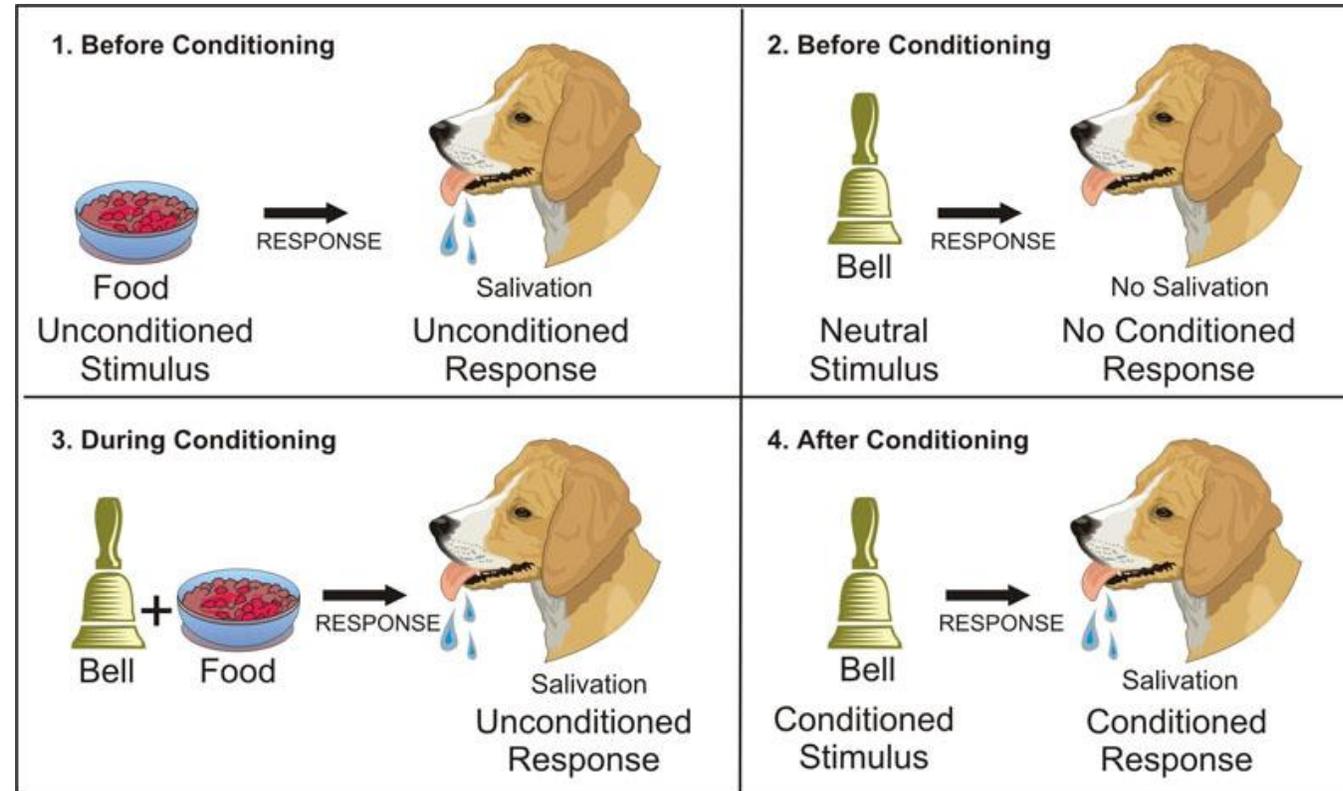


Pavlov was a physiologist studying digestion in the early 1900's.

Noticed 'psychic secretion'



Classical conditioning



Classical Conditioning



Classical conditioning and fear/pain

Classical conditioning is a type of associative learning: pairing two things together.

In this type of learning a previously neutral stimulus (Pavlov's bell) is paired with something important the animal was born knowing about (food) AND that 'something' results in unconscious reflexes in the body (salivation and release of feel good factors associated with eating).

Fear and pain learning often involves classical conditioning

Neutral stimulus: music

Paired with: electric shock causing pain (something you are born knowing about)

Unconscious reflex: flight / freeze

After a few pairings: MUSIC triggers the unconscious reflex of flight / freeze even without the presence of the electric shock



Classical conditioning and fear / pain

Fear conditioning can occur from a one off, life threatening experience.

Fear conditioning is an implicit – no need for conscious recall – type of memory.

When the stimulus that predicted the fear is encountered, the fear and its reflex outcome: flight / freeze or fight, is automatically, unconsciously triggered in the body.

These memories are believed to be stored in the amygdala itself – compared to explicit/ voluntary memories that are stored in multiple places across the forebrain.

This means that fear conditioned memories are rapidly accessed and acted upon and mostly, out of our conscious control.

CS veterinary nurse in proximity

CS vet nurse trying to touch DOG

Ucs fear of being restrained / fear of pain from being touched

Ucr growl / bite

CR growl / bite

Implicit fear / pain conditioning
Unconscious recall



Instrumental learning vs classical conditioning

Vet nurse approaches DOG

DOG growls and shows teeth

Explicit event memory
Conscious recall

Vet nurse shouts at DOG and grabs
By scruff of neck

Positive punishment
For growling at vet nurse approaching

?Less likely to growl at approaching vet nurse /
strangers in the vet hospital in the future.

Less likely to be scared of vet nurse in future? NO

Options:

Growl in the future: one “telling off” doesn’t affect DOG

Bite in the future: learn not to offer growl first

Freeze in the future: still fearful but inhibit behaviour

CS veterinary nurse in proximity
CS vet nurse trying to touch DOG
Ucs fear of being restrained / fear
of pain from being touched
Ucr growl / bite
CR growl / bite

Implicit fear / pain conditioning
Unconscious recall



Neutering and behaviour

***Fear and / or stress created by the neutering procedure**

***Hormonal changes as a result of the neutering process**

- Removal of testosterone – the ‘confidence’ giving hormone

- Removal of oestrogen / progesterone / folliculin – female hormones related to nesting behaviours, food acquisition , resource sharing

Neutering males and behaviour

Castration of male dogs may even increase the likelihood of aggression developing in some individuals (7-12 months of age when castrated 26% more likely to show aggression towards strangers) Farhooody, Serpell et al 2018

Testosterone reduces activation of the HPA axis – reducing cortisol production. Testosterone has also been shown to have specific fear reducing properties (Van Honk et al 2005)

Although intact males have been shown to have higher cortisol levels than castrated males Sandri 2015

Kauffman et al (2017) also found the behaviour of neutered males to be more reactive and less 'emotionally stable' at times of stress.

In an owner questionnaire based study, Roulaux and colleagues 2019, found that whilst 58% of owners gave "correcting undesirable behaviours" as the reason for choosing to castrate their male dog, 50% of those owners reported the undesirable behaviour to be aggression.

However, the majority of these owners reported no change to their dog's aggressive behaviour post castration and a number of owners who had not reported aggression in their dogs PRE castration, did find their dogs developing aggressive behaviours after castration.

ONCE ITS DONE – THERE'S NO GOING BACK!

Neutering males and behaviour

“The current data indicate that some forms of aggression, a category of response intimately connected to fear, is significantly and positively associated with lower AAC (age at castration) and PLGH (percentage lifetime exposure to gonadal hormones). This aligns with previous evidence that shyness (as opposed to boldness) is higher in castrated dogs. It is possible that, during the transition through puberty, sex hormones play a role in proofing dogs against fearfulness in later life.

So the current findings present the paradox that castration may reduce the numbers of unwanted dogs but may also increase the likelihood of problem behaviours that reduce the appeal of the castrated dogs and make them more vulnerable to being surrendered.”

McGreevy, P.D., Wilson, B., Starling, M.J. and Serpell, J.A., 2018. Behavioural risks in male dogs with minimal lifetime exposure to gonadal hormones may complicate population-control benefits of desexing. *PLoS One*, 13(5), p.e0196284.

Neutering males and behaviour

Sexual frustration – its role in behaviour problems

Younger dogs, particularly the adolescents, appear more easily affected by frustration

Rising levels of testosterone drive the tendency to roam and search out a suitable mate.

The inability to carry out this behaviour of roaming, locating and having sex can be a considerable stressor to some intact male dogs. (Their ability to smell hormonal changes in females possibly over miles may mean an owner is unaware of the source of the frustration)

The presence of likely frustration driven behaviours:

- development of frustration based aggression incl. redirected aggression

- increased amounts of displacement activities

- the development of repetitive behaviour problems such as stereotypies or compulsive disorders

might need to be considered in relation to rising testosterone levels in the peripubertal male dog.

Careful evaluation of an individual male dog with these tendencies in relation to fear versus frustration may need to be taken before considering whether lowering / removing gonadal hormones may be helpful in resolving the behavioural issue.

Medications for reproductive hormone related behaviours

Anti-Testosterone medications

Tardak injection (delmadinone)

Suppresses testosterone for 3-6 weeks – cannot be removed

PROS

Short acting if negative SE seen.

Limited effect on long term fertility

CONS

Has been linked to rare cases of adrenal gland suppression and development of Addisons

Cost

Suprelorin subcutaneous implant (deslorelin)

Suppresses testosterone for approx 12 months – cannot be removed

Not linked with adrenal gland suppression

More likely to have long term effects on fertility

Hard to predict duration of effect (?4 months to 12 months)

Longer acting if negative SE seen.

Larger needle size = more pain on injection

Cost

Neutering females and behaviour

ONCE ITS DONE – THERE'S NO GOING BACK!

Ovariohysterectomy of bitches has been shown to increase reactivity in German Shepherds who had the procedure done between 5 – 10 months of age (Kim et al 2006)

Ovary removal in female Vizlas has been shown to increase the tendency of fear issues such as thunderstorm phobias (Zink et al 2014)

Ovariohysterectomy of female spaniels has been linked to increased aggression towards the owner as well as increased aggression towards unfamiliar adults. They were also more likely to physically bite compared to intact females. (Reisner et al 2005)

Phantom pregnancies are most commonly recognised in entire bitches, but it can also develop as a result of spaying, particularly if susceptible bitches are spayed during dioestrous. Unless the relationship between spaying and the onset of clinical signs is very clear, vets may be less likely to recognise pseudopregnancy in a spayed bitch. It may be one cause of the increase in reactivity and/or aggression in bitches after being spayed (Root et al 2018)

DHEA (dehydroepiandrosterone which has nerve cell protective effects) declines steadily during adult life in ovariectomised females, whereas intact females showed no decline until old age. Mongillo et al 2014
Increasing studies are suggesting cognitive decline is more prevalent in females who have been gonadectomised.

Neutering females and behaviour

“ As in the associated study on neutered male dogs, we found that female dogs with less exposure to their natural gonadal hormones (decreased PLGH percentage lifetime exposure to gonadal hormones) showed greater incidence of several fear/anxiety, aggressive, and excitable behaviours than entire female dogs in contexts such as being barked or growled at by an unfamiliar dog, when the doorbell rings or an unfamiliar person visits the home, and when approached by an unfamiliar male dog.

Responsible pet ownership does not end with having one's pet gonadectomised.

Rearing dogs and managing them in ways that meet their behavioural needs and enrich the bonds they share with their owners must be given priority as a form of preventative care.

The challenges that owners face and the role of unwanted behaviours in jeopardising the human-dog bond should not be underestimated by simple, broad-scale policies.”

Considering neutering

INFORMED OWNER CONSENT

Aware medical PROS & CONS

Aware more behavioural CONS than PROS

Aware various options eg castration vs vasectomy

Aware of adolescent fear period: avoid 7-12 months of age?

Ensure dog not in fearful period by considering behaviours and activities at time of surgery

Female dogs to be in anoestrus

Consider antianxiety medication given at home before trip to surgery on the day (gabapentin, propranolol etc)

Adequate pain relief for several days

Post operative wound management plan (to avoid ECs)

Post operative sleep and enrichment plans



What can we do if we've got it wrong?

*Hormone therapy NOT REALLY

*Melatonin

In a recent study, melatonin (3mg/10kg) given to castrated males increased their serotonin concentration, reduced their cortisol levels and increased their testosterone levels. Salavati, Nazifi et al 2018

In a second study, melatonin (3mg/10kg) given immediate postoperatively (castration) for 1 month, reduced inflammatory proteins and cytokines compared to when given for 1 month to intact males and to castrated males where melatonin was not given. Nazifi et al 2020

*Behaviour modification for the learning theory (extinction, systematic desensitisation or counter conditioning)

*Anti-anxiety medications (SSRIs, GABA ergic, oxytocin in the future??)

*Environmental enrichment programmes



Summary

- *Neutering both male and female dogs will help population control
- *Neutering both male and female dogs can have positive medical outcomes
- *Neutering both male and female dogs can have negative medical outcomes
- *Neutering both male and female dogs has limited positive behavioural outcomes
- *Neutering both male and female dogs can have negative behavioural outcomes

Neutering affects behaviour due to a combination of learning theory AND physiological changes that result.

Neutering both male and female dogs has welfare implications that must be factored in to an INFORMED discussion with any owner / care giver considering the procedure for an animal.

“The quality of our efforts, is the quality of their life”

UNDERSTAND ANIMALS 2020



Useful references

Kutzler M A 2020 Gonad – sparing surgery surgical sterilization in dogs *Frontiers in Veterinary Science* 7 p342

Kutzler, M.A., 2020. Possible Relationship between Long-Term Adverse Health Effects of Gonad-Removing Surgical Sterilization and Luteinizing Hormone in Dogs. *Animals*, 10(4), p.599.

McGreevy, P.D., Wilson, B., Starling, M.J. and Serpell, J.A., 2018. Behavioural risks in male dogs with minimal lifetime exposure to gonadal hormones may complicate population-control benefits of desexing. *PLoS One*, 13(5), p.e0196284.

Root, A.L., Parkin, T.D., Hutchison, P., Warnes, C. and Yam, P.S., 2018. Canine pseudopregnancy: an evaluation of prevalence and current treatment protocols in the UK. *BMC veterinary research*, 14(1), p.170.

Roulaux, P.E., van Herwijnen, I.R. and Beerda, B., 2020. Self-reports of Dutch dog owners on received professional advice, their opinions on castration and behavioural reasons for castrating male dogs. *PloS one*, 15(6), p.e0234917.

Starling, M., Fawcett, A., Wilson, B., Serpell, J. and McGreevy, P., 2019. Behavioural risks in female dogs with minimal lifetime exposure to gonadal hormones. *PloS one*, 14(12), p.e0223709.

Urfer SR and Kaeberlein M 2019 Desexing dogs: a review of the current literature *Animals* 9(12) p1086





Understand Animals

Send Message