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No evidence for detrimental effect of chemical castration on working ability in Swiss military dogs

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ABSTRACT

Hormones influence the social behaviour of dogs. Castration of male dogs induces a reduction of testosterone and has been shown to affect social behaviours associated with aggression and reproduction. Changes in social behaviour could be critical in working dogs, which should be well trainable and behave reliably. It is currently unknown whether and how castration may affect the working ability of dogs. Besides surgical castration, chemical castration using a hormonal implant offers a possibility to castrate dogs temporarily. In the present study, we chemically castrated male Swiss military dogs and assessed their working abilities in comparison to intact males in a standard behavioural test series for Swiss military dogs (obedience, protection of the handler against an attacker, search of a hidden person in a building, reaction to social environment during a city walk). Chemical castration in Swiss military dogs had no measurable effect on any of the test situations in comparison to intact males.

1. Introduction

Hormones are important regulators of social behaviour (Wingfield et al., 1987; Bender et al., 2006). High androgen activity is linked with a high social status in various vertebrate species (Beaver and Amoss, 1982; Oliveira et al., 1996; Cavigelli and Pereira, 2000; Poisbleau et al., 2005; Bender et al., 2008), whereas an increased cortisol level is typically associated with stress (De Vries et al., 2003; Dickerson and Kemeny, 2004). Hormonal changes in puberty, for instance, are well-known for their effects on social behaviour. Brain development and therefore, changes of specific social behaviours, are caused by elevated levels of gonadal steroid hormones (Sisk and Zehr, 2005).

Dogs are highly social animals that are well known for their social skills and propensity to cooperate (Mersmann et al., 2011; Miklósi and Topál, 2013; Quervel-Chaumette et al., 2015; Gfrerer and Taborsky, 2017; Gfrerer et al., 2017; Gfrerer and Taborsky, 2018). These abilities are commonly used by humans for various purposes, where usually dogs are trained to fulfil particular tasks and roles. It is currently unclear how the working performance of dogs is affected by their hormonal status, particularly regarding steroid hormones (including androgens; Serpell and Hsu, 2005). This is an important gap because the castration of dogs may be a useful measure facilitating the handling of working dogs, as it might reduce aggressive tendencies and reproductive motivation. In Switzerland, and to our knowledge also in other countries, dogs used by the military and police are usually not castrated.

Neutering or castration refers to the surgical removal or chemical suppression of the reproductive organs, which results in reduced testosterone levels (Palm and Reichler, 2012). Castration may impact sexually dimorphic behaviour patterns in male dogs such as status related aggression, urine marking, mounting, house-soiling or roaming, yet current evidence is ambiguous (Hopkins et al., 1976; Kuhne, 2012). Concerns are often raised by dog handlers that castration of male dogs may impair their working abilities, e.g. because testosterone might be important for their physical performance and therefore, castrated individuals seem to walk like seniors. Second, oestrogens might delay senility (Strodtbeck and Ganslosser, 2011). Nevertheless, a study on different dog breeds found no clear association between neuter status and trainability, although neutering was positively associated with trainability in male Shetland sheepdogs (Serpell and Hsu, 2005). Data on the impact of castration on working ability of dogs are yet missing.

The effects of castration on aggression are particularly unclear (Hsu and Sun, 2010). Some studies found a decrease of aggression in castrated dogs (Borchelt, 1983; Gershman et al., 1994; Messam et al., 2008; Kuhne, 2012), whereas others found opposite effects (Podberscek and Serpell, 1997a, 1997b; Guy et al., 2001; Kaufmann et al., 2017) or no significant differences at all (van den Berg et al., 2006; Bennett and Rohlf, 2007). Furthermore, one study reported that dominance

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aggression decreased after castration in male dogs, whereas it increased in females (Pérez-Guisado and Muñoz-Serrano, 2009). Owner-directed aggression was found to decrease after castration (Hsu and Sun, 2010).

In English Cocker Spaniels, castration did not seem to affect aggressive behaviour. Nevertheless, castration was a consequence of aggressiveness rather than its cause; owners of Spaniels showing aggressive behaviour were more likely to castrate their dog than owners of non-aggressive Spaniels (Podberscek and Serpell, 1996). Further studies suggested that castrated male dogs differ in their social behaviour from intact males, as they reacted more unpredictably in stressful situations and showed a higher tendency for aggressive behaviour and fear (Kaufmann et al., 2017). This might be an effect of reduced testosterone levels, because testosterone also acts as an inhibitor of fear-related aggression (Aikey et al., 2002). Furthermore, castrated dogs may gain attractiveness for intact dogs, which can lead to stressful interactions and may induce aggressive responses towards intact males (Kaufmann et al., 2017).

Besides surgical castration, male dogs can also be castrated chemically with the implant Suprelorin, which is a well-established medication to temporarily suppress fertility. It is subcutaneously implanted and releases a gonadotropin releasing hormone (GnRH) agonist after a single subcutaneous application for a minimum of 6 months (Palm and Reichler, 2012).

Positive effects of Suprelorin were described on hormonally induced undesirable behaviours of male dogs, such as hyper-sexuality, territorial marking and aggressive behaviour against other male dogs (de Gier and Vinke, 2010; Goericke-Pesch et al., 2010; Beata et al., 2016). Further, wildlife species such as cheetahs have been treated with implants to suppress fertility of males to avoid overpopulation in protected game reserves, without any recorded side effects (Bertschinger and Caldwell, 2016).

The aim of this study was to investigate experimentally whether chemical castration in adult male dogs (> 18 months) affects their working ability as determined in a series of working ability tests. If castration affected working ability, we would expect chemically castrated and intact males to perform differently in these standard tests. This would have implications for the use of working dogs in the military, police, and for other uses, as well as for animal welfare.

2. Material and methods

2.1. Experimental subjects

From 2014 to 2016 the Swiss military obtained 49 dogs with an age range of 18 to 55 months (mean: 27.07 months). Dogs were obtained from specialized dog handlers and belonged to four different working dog breeds (ESM: Table 1). All dogs were housed individually and they participated in daily trainings for their future work as protection or rescue dogs. Seven dogs (5 chemically castrated males, 2 intact males) did not participate in the whole test (because of injuries or when the dog owners (recruits) interrupted the military service before the date of the final test) and were therefore excluded from the analysis. This resulted in a full data set of 19 chemically castrated and 23 intact males (ESM: Table 1).

Table 1
Four assignments for the evaluation of the effect of chemical castration on working ability. The detailed regulations of this evaluation ("Konkordatsprüfung") are provided in the Appendix in Supplementary material.

Obedience (100 scores)	Walk on a leash, walk off leash, positions (sit / lay down), reaction to gunshot, walk through a group of people, recall with distraction, down-stay for 5 min
Protection (100 scores)	Attack towards a human, flight of the attacker, recall from the attacker
Social (50 scores)	Walk in town; reaction to people, conspecifics, cars and bicycles; train ride
Building (50 scores)	Search, barking, "penetration" behaviour, successful finding

2.2. Chemical castration

Suprelorin initially stimulates the pituitary GnRH-receptors, which leads to an increase in concentration of follicle stimulating hormone (FSH) and luteinizing hormone (LH) and therefore, an increase of sexual steroids. In male dogs, LH regulates the testosterone synthesis, whereas FSH stimulates the initiation and maintenance of spermatogenesis. Testosterone itself is needed for the spermatogenesis and important for secondary sexual characteristics such as territorial marking, mounting and aggressiveness (Kutzler and Wood, 2006). Deslorelin, which is a gonadotropin-realeasing hormone (GnRH) analogue that is continuously released by the implant Suprelorin, prevents the production of pituitary hormones and testosterone, and therefore suppresses the reproductive endocrine system of male dogs. Thus, the long-lasting effect is a downregulation of GnRH-receptors with a suppression of the pituitary-gonad-axis (Palm and Reichler, 2012).

After implantation, testosterone production decreases in the first three weeks and testis size declines in the first two weeks. Four to five weeks after injection, sperm quality decreases and after five to seven weeks ejaculate production is fully suppressed. The effect is reversible (Palm and Reichler, 2012). Possible side effects are an increase in appetite, the possibility of aconuresis as well as coat changes (Palm and Reichler, 2012).

In our experiment, male dogs were randomly selected for chemical castration. All dog trainers as well as the future recruits and the judge for the tests were unaware of the procedure and thus blind to treatment. The project was authorised by the Swiss military (license 15.001841).

2.3. Behavioural testing

We used a standard behavioural test series established by the Swiss military long ago (Table 1; Appendix: regulations of the "Konkordatsprüfung"). The test was conducted ten weeks after chemical castration. During this interval, the handlers and dogs were trained by the military service for their future work as protection dogs. In detail, they were exposed to daily trainings in obedience and in protection service, and in searching for a hidden person in a building.

The test series to study the effect of chemical castration on working ability consisted of four assignments including several tasks (Table 1). An external judge rated the teams consisting of handlers and dogs in the standard test routine used for police and military dogs. The test procedure lasted for one day; half of the test was conducted in the morning, the other half in the afternoon. The test took place within the Swiss military facilities "Sand". In addition, to test the dogs' reactions to the social environment (assignment "social" in Table 1), the teams of handlers and dogs went on a walk in the nearby village Schönbühl, Switzerland, which was also rated by the external judge.

2.4. Statistical analyses

We analysed the data with five linear models (obedience, protection, social, building assignments; and total) with the test scores as the dependent variable, using the software package R (R Development Core Team; version 3.2.5). Treatment (intact males or chemically castrated males) and the starting time of the experiment (spring or summer 2015 or 2016) were entered as fixed effects in the model. Tukey tests, with the package 'multcomp', were used to search for differences between the different time periods.

3. Results

None of the five linear models detected a significant effect of

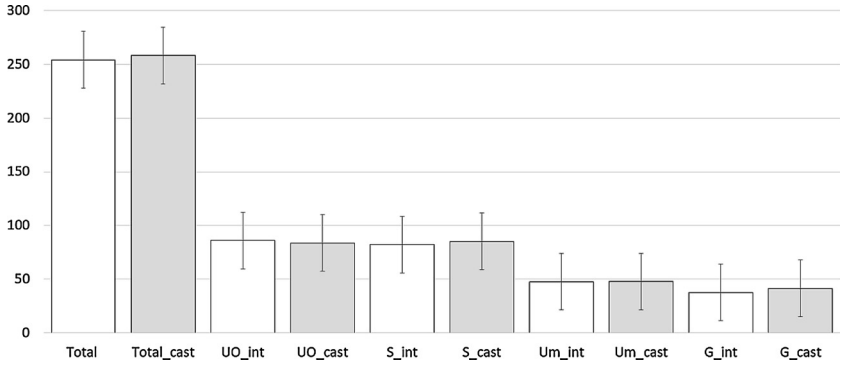

Fig. 1. Mean scores (with standard errors) of intact (white) and chemically castrated (grey) male Swiss military dogs in the standard test series ("Konkordatsprüfung"). There was no significant difference between intact and chemically castrated male dogs, neither in total (Total), nor in the single assignments (Obedience, Protection, Social, Building).

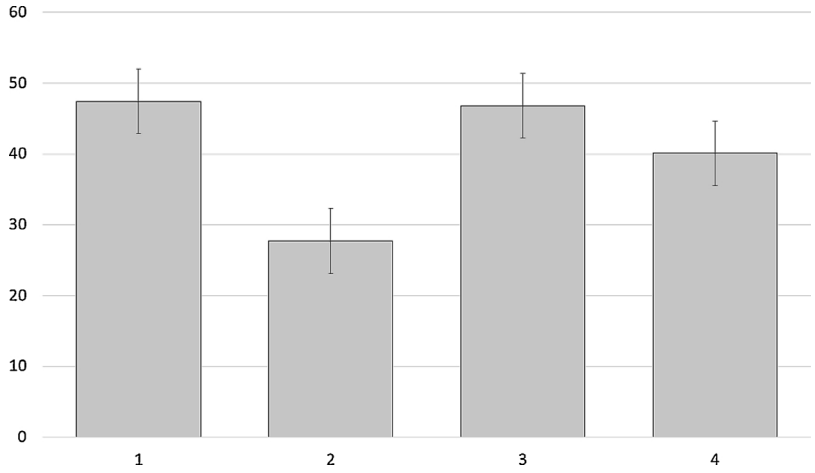

Fig. 2. Mean scores (with standard errors) between the four different test periods (spring 2015, summer 2015, spring 2016, summer 2016). There were significant differences between spring 2015 and summer 2015 ($p = 0.004$), and between summer 2015 and spring 2016 ($p = 0.006$).

treatment (Fig. 1; ESM Table 2 – Table 6). However, in one task ('building') we found a significant effect of the time period (Fig. 2, ESM: Table 6). The summer sample 2015 was significantly different from the spring sample 2015 ($p = 0.004$) and 2016 ($p = 0.006$).

4. Discussion

Although castrated and intact males may differ in their social behaviour (Kaufmann et al., 2017), there was no significant difference between chemically castrated and intact Swiss military dogs in their working ability in the standardised military test series. However, the timing of the tests had an effect on behaviour in the 'building' assignment. In the summer batch 2015, four dogs (two intact and two castrated males) obtained very low scores (5 and 8 points of 50, respectively). As it is known from previous studies that the environment affects searching efficiency (Hepper and Wells, 2005; Reed et al., 2011; Jezierski et al., 2014), we assume that the conditions were perhaps particularly difficult on that test day, resulting in lower test scores in these four dogs.

Overall, our results on effects of chemical castration in dogs reveal similar effects to those of surgical castration on the performance of pouched rats in mine-detection (Edwards et al., 2015). In these rats there was also no statistically significant difference between the experimental (castrated) and control (intact) groups. It had been concluded from this study that an invasive species used for specific working purposes can be reproductively controlled by castration without compromising their working performance (Edwards et al., 2015). Similarly, the present study found no evidence for an effect of chemical castration on the working ability of male Swiss military dogs.

Aggressive behaviour is an important trait of military dogs, especially for protection dogs. Despite testosterone being an important mediator of aggressiveness (Kutzler and Wood, 2006), our chemically castrated dogs fulfilled their working purposes similarly well as the intact controls. This might result from the standard reinforcement procedures following training. The dogs are usually rewarded with social play after a successful trial. In ferrets, chemically castrated males showed a higher incidence of play behaviour than intact males (Vinke et al., 2008). Here, we did not assess playful behaviour in the test dogs, but the motivation to play after a test might have influenced the working propensity of dogs, irrespective of their testosterone levels.

It had been reported that castrated male dogs are emotionally more unstable in stressful situations, showing a higher tendency for fear (Kaufmann et al., 2017). These findings are not supported by our results. The discrepancy between these two studies might result from the different experimental contexts. While the former study (Kaufmann et al., 2017) tested for the effects of castration in a social context, we focused on effects in different working tasks. Thus, the effects of castration can perhaps not be generalized, but may vary depending on context and aspect of behaviour.

5. Conclusion

Chemical castration of male dogs is a common practice in Switzerland since 2009. So far it has remained elusive whether and how such castration might change the abilities of working dogs to fulfil certain tasks. Our study suggests that chemically castrated males can perform their duties equally well as intact males.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.applanim.2018.10.019.

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