JOURNAL OF
SHELTER MEDICINE &
COMMUNITY ANIMAL HEALTH

ORIGINAL RESEARCH ARTICLE

Evaluation of Autoligation of the Spermatic Cord for Castration of Small Adult Dogs

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Abstract

***Introduction*:** Traditionally, when performing a canine castration, the spermatic cord is double ligated prior to removing the testicles. Double ligation with suture is thought to prevent hemorrhagic complications and has been considered necessary to prevent morbidity and mortality when performing these procedures. A relatively new technique has emerged where the spermatic cord is ligated on itself, or autoligated, in a manner similar to the way that feline spermatic cords are ligated when performing cat neuters. The purpose of this study was to evaluate the rate of complications across a large number of dogs whose spermatic cords were autoligated rather than double ligated with suture. At the time of the study there was no peer-reviewed publication of this scale providing information about post-operative complications that could result from using this specific technique.

***Methods*:** This case series included 215 shelter-owned dogs that underwent autoligation of the spermatic cord during routine open castration. Inclusion criteria included age of 5 months or older and body weight of 25 lbs (11.4 kg) or less. Age was obtained from records, when available, or estimated based on size, breed, and dentition. The primary outcome measure was defined as hemorrhage from the testicular pedicle, as the primary potential complication that would be expected from a novel or unproven ligation method. Thus, patients were monitored for intraoperative hemorrhage, postoperative bleeding, or development of a scrotal hematoma. Incisional bruising was also found but not attributed to bleeding from the testicular pedicle unless noticed to be overtly greater than what is observed with traditional canine castration surgery.

***Results*:** There were no intraoperative hemorrhage-related complications in any dog. In addition, none of the patients experienced postoperative bleeding nor did any patient develop a scrotal hematoma. Minor complications were all mild and self-limiting. These included peri-incisional bruising in 10/215 (4.7%) and scrotal bruising in 8/215 (3.7%) for an overall complication rate of 18/215 (8.4%). No dog required hospitalization or medical care related to any surgical complication.

***Conclusion*:** No severe complications were seen in this case series of 215 patients. Calculating the upper limit of the 95% exact binomial confidence interval suggests a maximum risk of 1.7% that severe complications would be encountered in performing this procedure. Therefore, the results of this study indicate that autoligation of the spermatic cord is a safe technique when used in the open castration of adult dogs that weigh 25 pounds (11.4 kg) or less. Anecdotally, many shelter veterinarians report using this technique and this publication serves to establish the safety of this practice, particularly for those practicing in high-quality/high-volume spay and neuter operations.

Keywords: *canine*; *dog*; *castration*; *neuter*; *orchiectomy*; *autoligation*; *spermatic cord*

Received: 30 January 2025;
Revised: 8 May 2025;
Accepted: 8 May 2025;
Published: 14 July 2025

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Traditionally, when performing a canine castration, the spermatic cord is double ligated with suture prior to removing the testicles.[1] Double ligation is thought to prevent hemorrhagic complications and has been considered necessary to prevent morbidity and mortality when performing these procedures. A relatively new technique has emerged where the spermatic cord is ligated on itself, termed autoligation (AL), in a manner similar to

Citation: Journal of Shelter Medicine and Community Animal Health 2025, **4**: 127 - http://dx.doi.org/10.56771/jsmcah.v4.127

the way that feline spermatic cords are autoligated when performing cat neuters. A previously published article[2] demonstrated that AL of the spermatic cord is safe in pediatric and juvenile dog castrations and, anecdotally, AL is routinely performed in adult dogs by practitioners who perform high quality/high volume neuter surgeries.

In our experience, AL of the spermatic cord in adult dogs has developed as a natural progression from utilizing this technique in pediatric and juvenile dogs. These surgeries have been performed in this institution for several years with no perceived increase in post-surgical complications. The main advantage of this technique appears to be that the spermatic cord can be autoligated in less time than it would take to double ligate the same structure. This perceived increase in efficiency would result in less anesthetic time and less surgical time. In addition, AL without suture material will result in less foreign material left in the patient and reduce the financial cost of the procedure. As shown in our previous work, these small but consistent gains in temporal and financial efficiency amount to substantial impacts in a high quality/high volume setting. At the time of the study there was no peer-reviewed publication of this scale providing information about post-operative complications that could result from using this specific technique.

Our hypothesis is that autoligation of the spermatic cord in adult dogs is a safe procedure and that complications, if any, will be comparable to double ligating the spermatic cord.

Methods

Animals

Three experienced spay/neuter veterinary surgeons (Rekers, Ferrel, Wixson) performed all of the surgeries in this study of 215 dogs that underwent castration using the AL method: Combined, these surgeons had over 30 years of surgical experience at the start of the study. Data collection started in August of 2019 and finished in November of 2023 during which time 215 dogs were enrolled in the study. Data collection was not continuous; interruptions occurred during data collection due to a global pandemic (COVID-19) and a subsequent change in personnel at the shelter. Scheduling of the surgeries was performed by shelter employees with no knowledge of the study. Patients were excluded from this study only if the surgeons were not available for surgery that day, and the patient was neutered by another surgeon, or if surgical patients were diverted for student teaching.

The AL technique was used by these surgeons in all dogs during this study period. At the beginning of the study this technique was already in use at the Oregon Humane Society so no new training or equipment was needed and there was no impact on the surgeons or surgical workflow. Inclusion criteria limited the patients to adult dogs who were 5 months of age or older. Age was obtained from the records when available, or estimated based on size, breed, and dentition. Additional criteria for inclusion in the study limited the dogs to 25 pounds or less in body weight. This was to ensure that the spermatic cord would not be too large to allow it to be safely autoligated. At the time of the study all of the patients were shelter dogs at the Oregon Humane Society. Patients were monitored for complications during recovery and in the perioperative period before returning to the kennel area. In addition, the patients were examined 24 h after surgery. One doctor (Miller), who did not perform the surgeries, completed all rechecks. Kennel staff and potential adopters were instructed to identify and report any post-operative concerns. Complications to be monitored for included intra-operative hemorrhage, post-operative bleeding, scrotal hematoma/seroma, and bruising at the incision site or scrotum. Any other unanticipated complications were recorded as well. Serious hemorrhagic complications were to be confirmed via exploratory surgery or necropsy: these were to be recorded and described.

Surgery

All patients were given buprenorphine (0.015 mg/kg IM) prior to anesthesia. Dogs that were between 6 months of age and 8 years of age were also given acepromazine (0.02 mg/kg IM) before induction. Midazolam (0.55 mg/kg IV) and ketamine (5 mg/kg IV) were used for induction and the patients were intubated and maintained on isoflurane in 100% oxygen for the duration of the procedure. Carprofen (4.4 mg/kg SQ) was administered after induction. The scrotal and prescrotal areas were clipped and scrubbed with 4% chlorhexidine and alcohol before dogs were moved into the operating room. The surgical procedure for this study consisted of a prescrotal approach with an open castration. Incision size conformed to the size of the testicle and was not recorded or reported. Open castration was chosen to ensure that the vessels of the spermatic cord would be securely ligated without interference from the vaginal tunic. The open technique was performed by incising the parietal vaginal tunic and exposing the spermatic cord prior to ligation. Autoligation of the spermatic cord was achieved using a figure-of-eight style knot or a simple overhand knot at the discretion of the surgeon.[3] Closure of the surgical site was achieved using a single cruciate suture to close the subcutaneous tissue and a single horizontal mattress suture in the intradermal layer to close the skin. Suture size was left to the discretion of the surgeon, consisting of either 2-0 or 3-0 monofilament absorbable material (Polydioxanone).

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Results

Average age of the 215 dogs that underwent castration using the AL method was 2.6 years (range, 5 months to 12 years) and the average body weight of the dogs was 6.14 kg (13.5 lb; range 1.9–11.36 kg [4.8–25 lb]). All 215 dogs had two spermatic cords autoligated (430 total autoligations).

There were no intraoperative hemorrhage-related complications in any dog. In addition, none of the patients experienced postoperative bleeding nor did any patient developed a scrotal hematoma. Minor complications were all mild and self-limiting. These included peri-incisional bruising in 10/215 (4.7%) and scrotal bruising in 8/215 (3.7%) for an overall complication rate of 18/215 (8.4%) (Table 1). No dog required hospitalization or significant medical care related to any surgical complication. Due to a moderate amount of peri-incisional bruising, one patient was given additional analgesic medications on an outpatient basis.

Discussion

In dogs, complications related to castration include scrotal inflammation and swelling, scrotal hematoma, incisional swelling or discharge, urethral trauma, and excessive patient attention to the surgical site.[4] Utilization of a novel or untested means of ligating a vascular structure may result in hemorrhage. Therefore, the patients in this study were monitored for evidence of hemorrhage including intra-operative hemorrhage, post-operative bleeding, scrotal hematoma/seroma, and bruising at the incision site or scrotum.

Our hypothesis for this study was that any complications that occur in autoligating the spermatic cord will be comparable to the number of complications encountered in previous studies where the spermatic cord was double ligated using suture. According to the literature, overall complication rates when castrating dogs range from 3.8 to 22% and major hemorrhage is not commonly associated with these procedures.[5] A study[6] evaluating complication rates in student surgeries at one teaching institution detected an overall postoperative complication rate of 22%: Observed complications largely included scrotal hematomas, incisional swelling, and incisional discharge. A more recent study[7] looking at complication rates in student surgeries had an overall complication rate of 3.8% in dog castrations. A study of complications following castration of dogs at six private veterinary practices detected an overall complication rate of 15%[8]. It was reported that complication rates ranged from 1 to 24% with major complication rates ranging from 1 to 4%. The rate of minor complications reported in this study compare favorably with previously reported complication rates. No severe complications were seen in this case series of 215 patients. Calculating the upper limit of the 95% exact binomial confidence interval suggests a maximum risk of 1.7% that severe complications would be encountered in performing this procedure (Table 1). Collectively, these data support our hypothesis and allow conclusion that autoligation of the spermatic cord is a safe technique when utilized in the castration of adult dogs that weigh 11.4 kg (25 lb) or less.

Table 1. Postoperative Complications

Complication	Number	Percent	95%CI
Intraoperative hemorrhage	0	0.0	0–1.7
Postoperative bleeding	0	0.0	0–1.7
Scrotal hematoma	0	0.0	0–1.7
Peri-incisional bruising	10	4.7	2.3–8.4
Scrotal bruising	8	3.7	1.6–7.2
No complications	**197**	**91.6**	**87.1–95**

Total number of dogs = 215; 95%CI = binomial 95% confidence interval calculated using the method of Bland M. *Detecting a Single Event*. York: British Standards Institution Study Day; 2013.

It should be noted and considered a limitation that some mild complications in this study could be related to clipping of hair, preparation of the surgical site, and general handling of tissues prior to surgery. Likewise, evidence of swelling or bruising may arise from another part of the procedure (e.g. lacerating a subcutaneous vessel). Bleeding during castration can originate from sources other than the spermatic cord.

Another potential limitation that should be considered when evaluating this study is the possibility that further incisional complications developed beyond the 24-h postoperative recheck. The average length of stay at the Oregon Humane Society is very low. This limits the ability to consistently schedule rechecks beyond 24 h. Adopters were instructed to monitor the surgical site and report any problems with the patient or the surgical incision. Most, if not all, of the patients would have returned to the shelter for treatment at no-cost rather than seeking care with their community veterinarian at the owner's expense. Therefore, the authors are confident that the present data set has captured any significant complications. Furthermore, researchers in one publication found that most complications were discovered within 24 h of surgery and that no complications were found 10 days post-surgery. The authors of that article openly questioned the value of rechecking patients more than a week post-surgery and advocated for rechecking patients in the immediate post-operative period.[9]

Finally, a study looking at postoperative complications in dogs undergoing open versus closed castrations found that open castration was associated with a significantly higher complication rate when compared to patients undergoing closed castration.[9] Complications associated with open castration in their study included scrotal

swelling and bruising. It should be noted that the mean weight of the patients in that study was 20.7 kg (45.5 lbs) whereas the average weight of patients in this study was 6.14 kg (13.5 lbs). It may be that open castration is associated with an increased complication rate when utilized in larger dogs, but more study is needed in this area. In addition, it is possible that the present technique may be safe in dogs larger than 25 lbs, but this would require further investigation.

Research has established that it is more efficient to autoligate a vascular structure, be it the ovarian pedicle or the spermatic cord, when compared to double ligation of the same structure.[2,10] To the authors' knowledge, double ligation is considered the traditional method of ligating the spermatic cord and is commonly taught in veterinary schools. Many high-quality, high-volume spay-neuter (HQHVSN) surgeons, including those trained by the American Society for the Prevention of Cruelty to Animals (ASPCA),[11] will use a single ligature to ligate the spermatic cord. The efficiency and safety of a single ligature verses double ligature of the spermatic cord is beyond the scope of this article. A recent study demonstrated substantial efficiency when combining autoligation of the spermatic cord with a scrotal approach in small adult dogs.[12] While that particular study was small, it demonstrates a promising path for future research. Although the focus of our project was to establish the safety of autoligating the spermatic cord in small adult dogs, it is reasonable to conclude that there would be a time savings as well.

Conclusion

The results of this study indicate that autoligation of the spermatic cord is a safe technique when utilized in the open castration of adult dogs that weigh 25 lbs (11.4 kg) or less. Anecdotally, many shelter veterinarians report using this technique and this publication serves to establish the safety of this procedure, particularly for those practicing in high-quality/high-volume spay and neuter operations.

Authors' contributions

Conceptualization – Miller, Rekers, Ferrel, Wixson, Milovancev
Data curation – Miller
Formal analysis – Miller, Milovancev
Funding acquisition – N/A
Investigation – Miller, Rekers, Ferrel, Wixson
Methodology – Miller, Rekers, Ferrel, Wixson, Milovancev
Project administration – Miller
Resources – N/A
Software – N/A
Supervision – Miller, Milovancev
Validation – Miller, Milovancev
Visualization – Miller, Rekers, Ferrel, Wixson, Milovancev
Writing – Miller, Milovancev

Acknowledgments

The authors would like to thank the Oregon Humane Society, specifically the Certified Veterinary Technicians, Veterinary Assistants, and Volunteers, who all contributed to the completion of this study.

Conflict of interest and funding

This research received no financial support from any source.

The authors declare no potential conflicts of interest.

Author notes

The abstract was presented at the American Board of Veterinary Practitioners Symposium in April of 2024 and published in the Journal of Shelter Medicine and Community Animal Health.

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