

A novel surgical technique for prolapsed fold excision in bitches with vaginal hyperplasia

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RESEARCH ARTICLE



ABSTRACT

Vaginal hyperplasia (VH) is a common condition, particularly in young bitches of certain breeds during the proestrus/oestrus period, and sometimes surgical intervention may be necessary. Bitches with VH at different stages were enrolled in our study (Type II-III). Excision of vaginal fold was performed using either the conventional technique (CG; $n = 10$) or the new technique (NG; $n = 12$). The extent of bleeding, ease, and duration of surgery were compared between the two groups. In the CG, surgeries were performed using the conventional technique with using multiple ligations, while in the NG, 2% jetocaine + adrenaline solution ($0.4 \text{ mL} \cdot \text{kg}^{-1}$) was injected submucosally at the base of the protruding vaginal fold and then removed by electrocautery without ligation. The vaginal defect created after excision of the vaginal fold was closed with Connell suture (simple continuous suture) using absorbable monocril in both groups. In the CG, the average surgery time was 40.80 ± 1.87 min, whereas in the NG it was 13.42 ± 2.27 min ($P < 0.05$). In the NG, surgery was much easier, as bleeding in the surgical area after excision was significantly reduced. Our novel surgical technique should be considered a new option for VH surgery in bitches because its initial results are safe and effective.

KEYWORDS

vaginal hyperplasia, perineal bulge, dog, vaginal surgery, haemostasis, brachiocephalic

1. INTRODUCTION

Any mass in the vagina of bitches may be caused by vaginal hyperplasia, true vaginal prolapse, vaginal tumour, urethral tumour, clitoral enlargement, uterine prolapse, or retroflexion of the urinary bladder into the vagina. For the differential diagnosis of a vaginal mass, a swab should be taken from the bitch during a vaginal examination, accompanied by a detailed history. Serum oestrogen (E2) and progesterone (E2, P4) levels should also be determined, and a biopsy should be performed if necessary (Johnston, 1989; Zambelli, 2022).

Vaginal hyperplasia (VH) in the bitches results from an excessive response to E2 stimulation of the vaginal wall during proestrus or early oestrus, or in the presence of ovarian tumours or cysts. E2 stimulation leads to mucosal oedema and keratinisation of the vaginal wall in bitches. In some young bitches, E2 stimulation can also cause the vaginal wall to grow and is characterised by the protrusion of a pear- or doughnut-shaped oedematous mass through the vulva (Alexander et al., 1961; McNamara, 1997; Munnich et al., 1999). VH is most commonly observed in young (<3 years), intact, large-breed females during the follicular phase, especially in their first three oestrous cycles. In one study, VH occurred in 58.5% of large-breed bitches, 36.6% of medium-breed bitches, and 4.9% of small-breed bitches. As VH is thought to be hereditary, these bitches should not be used for breeding (Barner, 2008; Johnston et al., 2001).

In the literature, VH is also referred to as vaginal fold prolapse, estrus hypertrophy, vaginal eversion, or vaginal protrusion (Angulo, 2009; Post et al., 1991; Rushmer, 1980).

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A pale pink vaginal mass with a smooth surface, pear or doughnut shape, and soft consistency are diagnostic features of VH. VH may present solely as a small, pink perianal swelling. In such cases, the vaginal mass is visible only when the labia are parted, or it protrudes between the labia (Type I VH). In type II VH, the protruding vaginal mass typically originates from the ventral wall cranial to the urethral papilla and may involve the lateral walls of the vagina (Type II VH). Type III VH is a protruding vaginal mass consist of a doughnut-shaped entire vaginal circumference (Type III) (Canooğlu, 2013; Pettit, 1998; Purswell, 2005; Sarrafzadeh-Rezaei et al., 2008; Schaefer-Okkens, 2001). Smears reveal intermediate cells, keratinised and non-keratinised superficial cells, erythrocytes, and neutrophils, as is typical in proestrus and oestrus.

The condition usually regresses spontaneously in cases of Type I and in some Type II cases after cessation of oestrus or following ovariectomy or ovariohysterectomy (Antonov et al., 2023). The protruding hyperplastic vaginal mass may become painful as it hangs from the labia and becomes increasingly oedematous and enlarged over time. At the beginning of the condition, the surface of the VH is smooth and moist, but if left untreated, it dries out, turns bluish-purple, and ulceration develops. When vaginitis results from licking or rubbing, vaginal discharge may have a foul odour, and bleeding may sometimes occur. Oedema can increase urethral pressure and cause strangury; haematuria and tenesmus may also occur in some cases. In chronic cases, the general condition of the bitch deteriorates (Rushmer, 1980; Johnston et al., 2001). Excision of prolapsed tissue is required in bitches with Type III and with some Type II vaginal hyperplasia, which is less likely to resolve completely (Antonov et al., 2023).

1.1. Medical treatment options

Shortening the follicular phase to eliminate E2 can be attempted in VH if the vaginal mass is not necrotic. For this, gonadotrophin-releasing hormone (GnRH) ($2.2 \mu\text{g} \cdot \text{kg}^{-1}$, once, IM) or human chorionic gonadotrophin (hCG) (500–1000 IU, once, IM) can be used, and the vaginal mass may reduce within a week. During medical treatment, the bitch should be prevented from injuring the hyperplastic vaginal mass, and all precautions should be taken to prevent desiccation or infection of the hyperplastic mass. To prevent drying or infection of the mass, physiological saline, lubricant gel, antibiotic ointment, and 50% dextrose hyperosmotic solutions can be used (Alexander, 1961; Johnston, 1989; McNamara, 1997).

1.2. Surgical treatment options

Surgical approaches described in the literature include manual reduction of the VH followed by lacing of the vulvar lips, ovariectomy/ovariohysterectomy, and amputation of the hyperplastic vagina using various techniques. An older technique amputates the vaginal mucosa using a rubber band with two sutures (Post, 1991), while the conventional technique uses horizontal mattress sutures in a lock style

(Antonov et al., 2009; Johnston, 1989; Rushmer, 1980). Rejection of the mass by purse-string suturing technique has limited success, and the high concentration of E2 increases the risk of recurrence. Vulvar sutures are not recommended in dogs (Johnston et al., 2001).

Before VH surgery, if the vaginal wall is necrotic, supportive treatment should be performed, and if the urethra or urinary bladder has been displaced into the prolapse, this should be corrected according to its anatomical position. The vaginal wall is oedematous and vascular during proestrus/oestrus, and severe bleeding may occur during or after VH surgery. If vaginal bleeding occurs during a conventional method, haemostatic medications are used and an ice pack is placed on the perianal area to stop the bleeding. If the bleeding cannot be stopped with these measures, another surgical procedure is considered to find the source of bleeding and reseal it. If such a complication occurs, the duration of the procedure is prolonged, the risks of anaesthesia and infection increase, and the bitch may even die (Canooğlu, 2013).

In the present study, two surgical techniques (conventional mattress suture and a novel technique) were compared in bitches with different stages of vaginal hyperplasia the study design allowed: 1) comparison of the duration and ease of surgery between the two surgical groups, and 2) estimation of the volume of bleeding that usually occurs during vaginal fold prolapse surgery. Although vaginal hyperplasia has traditionally been treated in the operating theatre under general anaesthesia, the advantages of local anaesthesia are not documented. More specifically, local anaesthesia has reduced the need for postoperative analgesia and, along with adrenaline, reduces bleeding and allows earlier fulfilment of discharge criteria. This study also investigated these aspects.

2. MATERIALS AND METHODS

2.1. Animals

The study was conducted on 22 bitches with varying degrees of VH presented to our Gynaecology and Obstetrics Clinic between 2017 and 2020. Preoperative physical and vaginal examinations, as well as vaginal cytology, were performed. Age, weight, spaying status, previous pregnancy data, and urine status were checked and recorded. During the vaginal examination, the surface of the mass was checked for ulcers, and in all cases a urinary catheter was placed preoperatively to determine whether the urethra and/or bladder were located within the hyperplastic vaginal mass. All bitches in the study were intact. The breed distribution and clinical status of the bitches are shown in Table 1. According to this distribution, fifteen bitches were large (>25 kg), two were medium-sized, and five were toy breeds. None of the bitches in the study had previously had VH, as reported by the owners. Three bitches in CG and two in NG were primiparous, while the others in both groups were nulliparous. CBC and serum biochemistry profiles were performed and

Table 1. Clinical information of bitches

Bitch #	Age (Months)	Breed	Weight (kg)	Cycle	Involved vaginal wall(s)	SOU
NG 1	6	Pitbull	18	Oestrus	2L + V + D	±
NG 2	60	Sivas Kangal	50	Oestrus	2L + V	±
NG 3	60	Pug	9	Oestrus	V	+
NG 4	7	Cane Corso	26	Dioestrus	2L + V + D	+
NG 5	36	Sivas Kangal	40	Oestrus	2L + V	+
NG 6	24	Pug	8	Prooestrus	2L + V	+
NG 7	12	Dogo Argentino	28	Oestrus	V	+
NG 8	8	Sivas Kangal	28	Oestrus	2L + V	+
NG 9	24	Pug	8.8	Prooestrus	2L + V	+
NG 10	9	American Akita	35	Oestrus	2L + V + D	±
NG 11	9	Cane Corso	30	Oestrus	2L + V + D	±
NG 12	24	Sivas Kangal	40	Oestrus	2L + V	±
CG 1	24	Sivas Kangal	28	Oestrus	2L + V	+
CG 2	8	Husky	18	Oestrus	V	+
CG 3	60	Sivas Kangal	50	Prooestrus	2L + V	+
CG 4	30	Pug	7	Dioestrus	2L + V + D	±
CG 5	16	Sivas Kangal	38	Oestrus	2L + V	+
CG 6	48	Pug	7	Oestrus	2L + V + D	+
CG 7	8	Sivas Kangal	30	Prooestrus	2L + V	+
CG 8	24	Sivas Kangal	65	Oestrus	2L + V + D	+
CG 9	54	Sivas Kangal Mix	45	Dioestrus	V	+
CG 10	132	Sivas Kangal	35	Dioestrus	V	+

+: normal urination ±: dysuria L: lateral fold prolapse V: ventral fold prolapse D: dorsal fold prolapse SOU: state of urination.

within normal limits in all bitches before surgery. Only type II and III of bitches were involved in the study. The bitches were randomly divided into two groups and prepared for surgery: the conventional technique group (CG; $n = 10$) or the novel technique group (NG; $n = 12$). This study was conducted in accordance with the guidelines and with the approval of the Ethics Committee of the Faculty of Veterinary Medicine, Istanbul University-Cerrahpaşa (approved protocol #2018/03).

2.2. Surgeries

The surgeries were performed by the same surgeon under general anaesthesia, and a urinary catheter was stabilised in all cases before surgery. The anaesthetic procedures and postoperative assessments were carried out by one anaesthetist. The bitches were pre-medicated with a subcutaneous injection of atropine sulphate ($0.02 \text{ mg} \cdot \text{kg}^{-1}$) (Atropin; Teknovet, Türkiye), and anaesthesia was induced with $5 \text{ mg} \cdot \text{kg}^{-1}$ propofol (Pofol $10 \text{ mg} \cdot \text{mL}^{-1}$, Braun, Germany), intravenously (IV) to effect to allow endotracheal intubation with an appropriately-sized cuffed endotracheal tube. Anaesthesia was maintained with isoflurane (Forane Likit; Abbott, Aesica Queenborough, England) at a concentration of 2.5–3.5% mixed in 100% oxygen using a suitable anaesthetic breathing system. All bitches breathed spontaneously during the surgeries and received an injection of $0.2 \text{ mg} \cdot \text{kg}^{-1}$ meloxicam (Melox $10 \text{ mg} \cdot \text{mL}^{-1}$; Nobel İlaç Ltd., Turkey) intramuscularly after the induction of anaesthesia. Depth of anaesthesia was evaluated by the muscle tone of the jaw, pupil dilation and response to surgical stimulation. Respiratory rate (RR) was recorded using a multi-parameter

anaesthetic monitoring device (SMS, 2000 Classic Auto Anaesthesia Device CWH 1020, SMS Medical, Turkey). Systolic blood pressure (SBP) and heart rate (HR) were measured non-invasively, using an oscillometric method. An automatic pneumatic cuff was wrapped around the distal forelimb and connected to the monitoring device (S + B medVET GmbH, Babenhausen, Germany). Data (SBP, HR and RR) were recorded at the beginning of surgery and every five minutes after induction of anaesthesia until completion of VH surgery (Höglund et al., 2016).

The bitches were randomly assigned to one of two groups. Average surgical time (from incision to mucosal wound closure), the length of surgical thread and the number of sterile tampons used (to better understand blood loss) were recorded and compared within two surgical groups. During the surgeries, saline (0.9%) IV was administered at an infusion rate of $12 \text{ mL} \cdot \text{kg}^{-1}$ per hour in both groups. Before starting the surgery the protruding prolapsed vaginal fold(s) is pulled out of the vulva as far as possible. To avoid damaging the urethra, a semi-curved needle is inserted into the vaginal mucosa at least $\approx 1.5 \text{ cm}$ distal to the urethral orifice. In the conventional group, a horizontal interrupted mattress suture is placed, with each mattress suture passed within another in an interlocked pattern using an absorbable synthetic suture of No. 0/1 Poliglecaprone (Monocryl; Ethicon, Mexico). The free suture ends are knotted together, and the procedure continues with a purse-string suture using the conventional method. Prolapsed vaginal fold(s) is then excised with a Blend-2 electrocautery unit (Zeus-400 Electrosurgical Unit, Zerone Co. Ltd., Korea), and a circular circumferential incision is made on the vaginal mucosa with a disposable electrocautery (80 Watt).

After the removal of the hyperplastic vaginal portion, the vaginal defect is closed with an absorbable 2–0 Poliglecaprone synthetic suture (Monocryl; Ethicon, Mexico) in a simple continuous pattern.

Local anaesthesia technique (novel technique): This was performed after draping in NG, and local anaesthesia was administered into the prolapsed vaginal fold(s). After stabilising the syringe with both hands, a black hypodermic needle (22G $\times$ 1 1/4" (0.7 $\times$ 30 mm)) was used to inject 2% lidocaine HCL + adrenaline 0.0125 mg*/mL⁻¹ (Jetocaine ampoule; Adeka, Türkiye) diluted with isotonic saline (1:1) circumferentially submucosally along the presumed incision margin at 1–2 cm intervals (Kotb et al., 2023; Pedro José Pires Neto et al., 2017) (Fig. 1A). Local anaesthesia (lidocaine 4 mg*kg⁻¹) was administered, and at least 4 min are allowed for the solution to take effect (Margeti et al., 2024; Grubb and Lobprise, 2020) before cauterising and cutting the prolapsed vaginal fold(s) (Fig. 1B). The mucosal injection site should appear light pink to white after injection. The amount of 2% lidocaine with adrenaline injected may be

increased slightly depending on the size of the vaginal protrusion. Minor bleeding may occur during the injections, but it is insignificant. This colour change indicates ischaemia at the mucosal and submucosal injection site and shows the surgeon that a sufficient amount of solution was administered before resection of the vaginal mass. During the surgeries, a Blend-2 electrocautery (Zeus-400 Electrosurgical Unit®, Zerone Co. Ltd., Korea) was used, and a circular circumferential incision was made on the vaginal mass with a disposable electrocautery (80 Watt). Through this incision, all aspects were deepened, and the protruding vaginal fold(s) was resected. The vaginal defect (Fig. 1C) was closed with an absorbable synthetic 2–0 poliglecaprone suture (Monocryl; Ethicon, Mexico) using a Connell knot (Fig. 1D). Every steps of the surgery within the novel technique are shown in Fig. 2.

2.3. After surgery

Bitches in both groups were monitored closely for four hours during the recovery period after anaesthesia and were

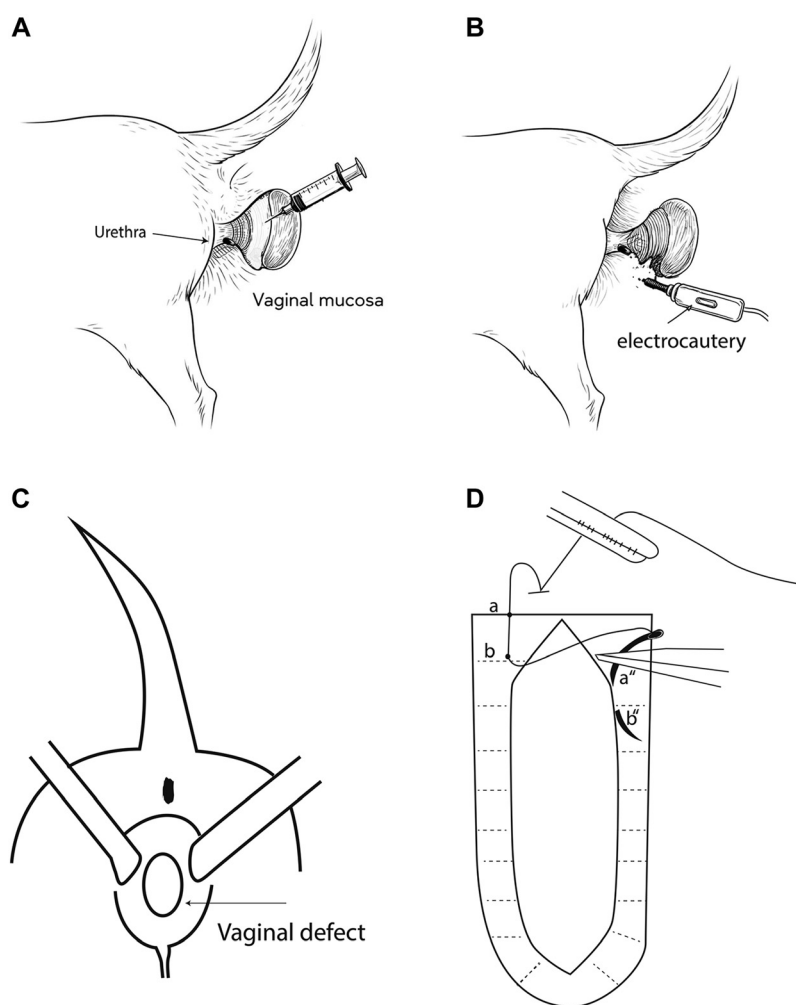


Fig. 1. Amputation of vaginal fold prolapse using a novel technique in bitches. A) Under general anaesthesia, local anaesthetic (2% lidocaine HCL + adrenaline) is applied circumferentially to several points at least 1.5–2 cm away from the orificium urethrae. B) Vaginal mucosa is amputated by electrocautery. C) Caudal appearance of vaginal defect after removal of prolapsed vaginal fold(s). D) Schematic diagram of the novel technique: Closure of the vaginal defect with Connell suture. Note the stitch pattern of a.a' near inside in b.b' near inside out

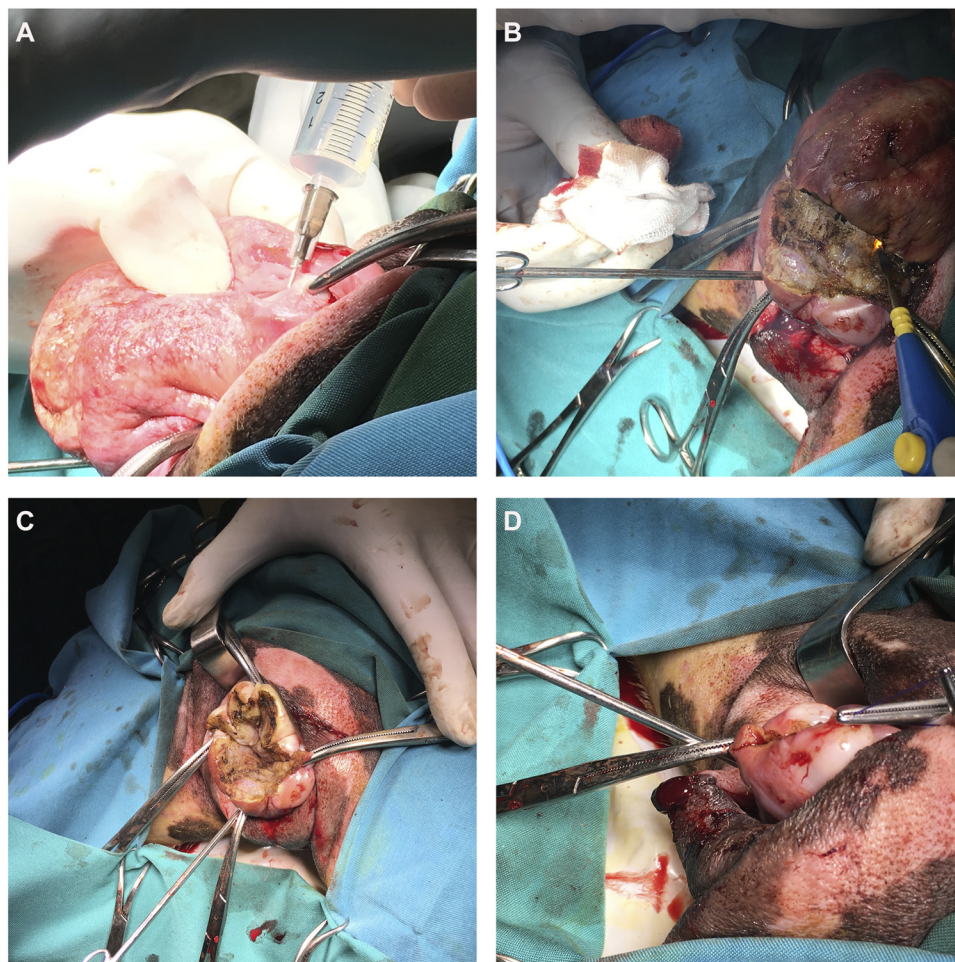


Fig. 2. Injection technique of local anaesthetic in bitches with vaginal hyperplasia showing clear and bloodless field a) 2% lidocaine HCl + adrenaline solution is injected submucosally into the hyperplastic vagina along the incision edge at 1–2 cm intervals. b) after injection, circumferential incision is made on prolapsed vaginal fold(s) and dissection using Blend-2 electrocautery (80 watts). c) bloodless field after resection of prolapsed vaginal fold(s) d) vaginal defect is closed with an absorbable synthetic 2–0 poliglecaprone suture using Connell knot

discharged home the same day. After surgery, ceftriaxone $20 \text{ mg}^* \text{ bw kg}^{-1}$ IM was prescribed for one week and meloxicam $0.2 \text{ mg}^* / \text{bw kg}^{-1}$ IM for three days. Owners were informed of emergency procedures and asked to restrict their bitch's exercise, ensure the wearing of an Elizabethan collar for at least three days, and monitor the bitch for bleeding.

2.4. Statistical analysis

The groups (conventional and new) were included in the statistical model as between-subjects effects, and an independent-samples *t*-test was performed to compare each parameter. A value of $P < 0.05$ was considered statistically significant.

3. RESULTS

3.1. Animals

In CG, 30% of bitches had VH involving the entire circumference (type III), 40% had prolapse involving two

lateral and ventral folds (type II), and 30% had ventral fold prolapse (type II). In NG, 33% of bitches had VH affecting the entire circumference, 58.33% had prolapse with two lateral and ventral folds, and 8.33% had only ventral fold prolapse. One bitch in CG and six in NG had difficulty urinating. The mean time from the development of VH to surgery was 12.5 days in CG and 6.4 days in NG.

3.1.1. Surgical results. The duration of VH surgery was 40.8 ± 5.92 min in CG, whereas it was 13.42 ± 7.87 min in NG ($P < 0.001$). The procedure was much easier to perform in NG than in CG, as no suture material was used for ligation and there was no bleeding during surgery. Although the amount of thread used varies depending on the type of VH, it has been determined that the new surgical technique significantly reduced the amount of thread required. The average length of surgical thread used during the operations was 20–45 cm (<1 pc) in the NG, compared to 225–375 cm in the CG ($P < 0.001$). The number of sterile tampons used was 1–2 pcs in the NG and 4–5 pcs in the CG ($P < 0.001$). Other surgical results for the two groups are shown in Table 2. All bitches were successfully operated on with the

Table 2. Anaesthetic evaluations of the two surgical groups during vaginal hyperplasia surgery

Anaesthetic parameters	Group	<i>n</i>	Mean ± SD	Std. error mean	<i>p</i>
RR-1 (breaths per minute)	NG	12	18.5 ± 7.3	2.116	<i>P</i> > 0.05
	CG	10	20 ± 5.6	1.764	
HR-1 (bpm)	NG	12	133.5 ± 24.6	7.099	<i>P</i> < 0.05
	CG	10	105.6 ± 13.3	4.193	
SBP-1 (mmHg)	NG	12	136.5 ± 37.66	10.870	<i>P</i> < 0.05
	CG	10	109.7 ± 9.5	3.011	
SBP-2 (mmHg)	NG	12	85.9 ± 30.74	8.875	<i>P</i> > 0.05
	CG	10	74.1 ± 14.3	4.508	
RR-2 (breaths per minute)	NG	12	29.9 ± 8.01	2.321	<i>P</i> > 0.05
	CG	10	29.6 ± 5.9	1.857	
HR-2 (bpm)	NG	12	115.08 ± 26.5	7.647	<i>P</i> > 0.05
	CG	10	104.8 ± 8.4	2.670	
BT (°C)	NG	12	38.5 ± 0.5	0.1523	<i>P</i> < 0.05
	CG	10	38.12 ± 0.2	0.0727	

RR-1: respiratory rate at the beginning of VH surgery, HR-1: heart rate at the beginning of VH surgery, SBP-1: systolic blood pressure at the beginning of VH surgery, SBP-2: systolic blood pressure at the end of VH surgery, RR-2: respiratory rate at the end of VH surgery, HR-2: heart rate at the end of VH surgery, BT: body temperature at the end of VH surgery, NG: novel group, CG: conventional group. bpm: beats per minute.

new technique; only one bitch experienced minor bleeding after surgery, which stopped without intervention.

4. DISCUSSION AND CONCLUSION

Veterinarians may sometimes find it difficult to decide on VH surgery, as complications such as bleeding and injury to the urethra can occur when operating on bitches with prolapsed vaginal folds. There are several options for the surgical treatment of VH, one of which is the amputation of the vaginal fold with two threads and an elastic band (Canooğlu, 2013; Post et al., 1991; Schaefer-Okkens, 2001). Another method is Antonov's mattress suture technique, referred to as the conventional method in this study. In this technique, a horizontal, interrupted mattress suture is used, and each mattress suture is passed within another mattress suture, forming an interlocked suture with absorbable suture material. The empty suture ends are knotted together and the prolapsed vaginal fold(/folds) are amputated (Antonov et al., 2009). Repositioning the vaginal fold into the vagina and suturing the labia with tobacco stitches to stabilise it in the vagina is another method, but it is generally not recommended because the high level of E2 in the bitch's blood makes her susceptible to relapse again, and there is a possibility that the vaginal fold will be constricted in the vagina, leading to necrosis. In a recent study, however, 14 bitches with complete protrusion of the vaginal mucosa were repositioned, and the labia were sutured with a Bühner suture after general anaesthesia. The authors reported that the results of their study were rewarding (Bucci et al., 2022).

In this study, no bleeding was observed with the novel surgical technique because 2% lidocaine + adrenaline solution was injected into the vaginal submucosa before removal of the prolapsed vaginal fold(s). Additionally, Connell suture

covers the mucosa and submucosa after excision of the vaginal mass and prevents bleeding.

The advantages of the novel technique can be summarised as follows:

1. There is no or very little bleeding in surgeries performed using this new technique.
2. The duration of the procedure is shorter with the new technique (13.42 ± 2.27 min) than with the conventional technique (40.80 ± 1.87 min), thus reducing the risk of anaesthesia.
3. Since the consumption of sterile gauze and suture material used in the surgery is very low, our new technique is much more economical than the conventional technique.
4. With the new technique, the trauma occurring during surgery is much less than with the conventional method and therefore post-operative comfort is expected to be better.
5. Since the scar tissue is much smaller with our new technique, the risk of postoperative vaginitis, vaginal adhesion, and stenosis is also reduced.

VH is most common in large breed dogs, although little is known about the genetic aspect of VH in bitches (Johnston, 1989; Sarrafzadeh-Rezaei et al., 2008; Schaefer-Okkens, 2001). In our study, there were fifteen large breed female dogs, two medium breed, and five toy breed bitches. Due to the hereditary nature of the disease, it is recommended that bitches with VH should not be bred. When genetic traits are considered and/or in recurrent VH cases, ovariohysterectomy is the best option (Hammel et al., 2002; Lightner et al., 2001; Wykes et al., 2003).

VH most commonly occurs during the proestrus or early oestrus phase of the bitch's oestrous cycle. In this study, the majority of bitches were in oestrus ($n = 14$), others four

were in proestrus and four were in dioestrus. Nine of the bitches were in their first three oestrous cycles. The most common type of VH is type II in our study which involved both the lateral and ventral vaginal walls ($n = 10$).

In a study on piglets ($n = 12$), lidocaine analgesia was used for castration. The study questioned the ideal time delay between lidocaine injection and the induction of anaesthesia. Radiolabelled lidocaine with adrenaline was injected into the testicle and subcutaneously in the scrotum. After a few minutes, the piglets were castrated. Results showed that when the injection was administered into the testicle, the highest concentrations of the drug were found in the spermatic cord three minutes after injection (Ranheim et al., 2005). In our study on bitches, amputation of hyperplastic vaginal mucosa with electrocautery was initiated four minutes after local anaesthesia with lidocaine and adrenaline. It is considered that this duration after injection of lidocaine is sufficient for local anaesthesia and haemostasis.

In a study on women ($n = 40$), surgical repair of rectocele and/or cystocele were done with vaginal local anaesthesia and according the authors, the technique presented had many advantages such as: minimal bleeding, which also alleviates the need for packing the vagina postoperatively; minimal dissection and tissue manipulation, quickly and with immediate discharge (Netto et al., 2021). Our results are in accordance with vaginal surgery on women, as there was little or no bleeding in surgeries performed using this novel technique. The duration of the procedure was shorter with the novel technique, it was much more economical, the trauma occurring during surgery is much less, and the risk of postoperative vaginitis, vaginal adhesion, and stenosis was also reduced. Our results, in accordance with vaginal surgery on women (Netto et al., 2021).

Another study in tom cats ($n = 39$), using lidocaine local anaesthesia before castration via intratesticular and subcutaneous scrotal administration, showed that the nociceptive response to surgery was alleviated. Heart rate variability analysis revealed significant differences between the local anaesthesia and no anaesthesia groups, indicating that this method is a promising research tool to estimate intraoperative nociception in cats during general anaesthesia (Moldal et al., 2013). In another study in dogs ($n = 19$), investigation of pre-surgical intratesticular injection of lidocaine showed a reduction in intraoperative heart rate and mean arterial pressure during castration. Based on the results, the authors recommend the use of intratesticular lidocaine for surgical castration in dogs (Huuskonen et al., 2013). In our study, heart rate and systolic blood pressure at the beginning of VH surgery were statistically different between the two groups ($P < 0.05$). Our result is in accordance with this study.

In conclusion, our study describes a novel surgical technique we named the Kırşan technique, for bitches with varying degrees of VH. The Kırşan technique was well tolerated by all bitches in this study and, in our opinion, can eliminate most postoperative problems (bleeding, discomfort, and pain) that occur after conventional VH surgery.

The authors conclude that bleeding during and after VH surgery can be easily prevented by the Kırşan technique, and this technique can be a good alternative to VH surgery in bitches.

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