

Original Article

Autologous tunica vaginalis graft to repair perineal hernia in shelter dogs

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ABSTRACT

In an effort to reduce shelter intake, Miami-Dade Animal Services (MDAS) Pet Retention Program offers caretakers with an opportunity to have animals treated for certain medical conditions, free of charge. Discovery of new, simple surgical techniques for low-cost procedures provides veterinarians with more surgical solutions, expands the capacity for services provided through low-cost veterinary clinics and other shelter programs, and provides shelters with life-saving alternatives that will increase adoptability of homeless pets and reduce euthanasia rates. The aim of this clinical trial was to describe and to evaluate the use of the autologous tunica vaginalis communis as a free graft to repair perineal hernia (PH) in intact male dogs at an animal shelter facility. In 2018, seven male intact dogs, diagnosed with perineal hernias (PH), were presented to MDAS. All dogs had the surgical reconstruction of the pelvic diaphragm repaired by using the tunica vaginalis communis obtained at the time of castration, prior to the perineal access, and sutured directly into the perineal defect. Clinical outcome including postoperative complications and hernia recurrence were obtained via telephone communication. The median follow-up time was 13 months. None of the dogs included in this study had recurrence of the PH. All dogs were adopted, were transferred to animal rescue organizations or were returned to their owners after the surgical procedure. The use of tunica vaginalis communis autograft is a simple, low-cost surgical technique that requires less surgical expertise and training and can be used for perineal herniorrhaphy in dogs, without long-term recurrence.

Introduction

The efforts to reduce euthanasia and increase live release rates (LRR) in shelters have drastically increased (Griffin et al., 2016). The ability to perform more advanced surgical procedures such as hernia repair on shelter patients, represents a critical component in improving live outcomes, by improving adoptability, and reducing euthanasia rates in shelters. The ability to perform more advanced surgical procedures on shelter patients represents a critical component in improving live outcomes, by improving adoptability, and reducing euthanasia rates in shelters. The most common surgical procedures performed at Miami-Dade Animal Services (MDAS) besides sterilization surgeries include enucleations, limb amputations, wound repairs, hernia corrections, eyelid defects, skin grafts, mastectomies and other mass removals. These procedures are performed following basic surgical standards; however, an effort is made on minimizing costs and targeting animals that are at most risk for relinquishment and euthanasia due to their presenting medical conditions.

A perineal hernia (PH) is a common disorder in mature male intact dogs (Gill and Barstad, 2018). A structural weakness of the pelvic

diaphragm results in lateral deviation of the rectum or protrusion of abdominal or perineal viscera into the perineum (Biondo-Simoes et al., 2017). The underlying cause of the weakening is not completely determined, although it is likely to be multifactorial (Merchav et al., 2005). Diagnosis is made based on clinical signs and through a rectal examination. Clinical signs will depend on the hernia contents and may include perineal swelling lateral to the anus, tenesmus, dysquesia, fecal incontinence and dysuria (Hosgood et al., 1995).

Surgical reconstruction of the pelvic diaphragm is usually recommended for PH repair. Surgical techniques including simple muscle apposition, muscle flap transposition (internal obturator muscle, superficial gluteal muscle, semitendinosus muscle) (Mortari et al., 2005; Morello et al., 2015) and the use of implants or graft techniques (synthetic mesh, porcine small intestinal submucosa, canine small intestinal submucosa, autologous tunica vaginalis) have been described to treat PH (Stoll et al., 2002; Tanaka et al., 2004; Szabo et al., 2007; Lee et al., 2012; Pratummintra et al., 2013; Guerios, et al., 2017). Some reports recommend a combination of colopexy, vasopexy and/or cystopexy, and perineal herniorrhaphy due to severe displacement of organs (Gilley et al., 2003; Brissot et al., 2004). Castration is recommended at

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the time of herniorrhaphy to reduce the incidence of recurrence (Snell et al., 2015). Frequent complications observed after PH repair include wound infection and dehiscence, persistence of clinical signs such as tenesmus and fecal incontinence, rectal prolapse and hernia recurrence (Hosgood et al., 1995).

The tunica vaginalis communis has been experimentally used for reconstruction of abdominal wall defects, urethral defects, urinary bladder defects and hernia repair (Hafeez et al., 2005; Leslie et al., 2009; Wongsetthachai et al., 2011). The autologous tunica vaginalis communis was described by Pratummintra (2013) to repair PH in 9 dogs. In this report, a success rate of 90.91% was achieved by harvesting the tunica vaginalis communis via closed orchietomy prior to the herniorrhaphy (Pratummintra et al., 2013). The aim of this case study was to describe the successful use of a low-cost surgical technique that requires low surgical training and expertise as an alternative for PH repair in shelter dogs as well as reporting the outcome and recurrence rate in dogs treated with an autologous tunica vaginalis communis.

Materials and Methods

During 2018, ten male dogs were diagnosed with PH at the MDAS shelter. All animals included in the study were intact male dogs that had a perineal hernia confirmed by rectal examination and were surgically treated with an autologous tunica vaginalis communis. Cases with a minimum 11 months follow up were included. Pre-surgical evaluation included clinical signs and a complete physical examination. Three days before surgery, patients were prescribed lactulose (0.3ml/kg, PO, twice a day) as a stool softener. Administration of subcutaneous Ringer Lactate fluids (25ml/kg) and manual removal of the feces were performed on the surgery day when fecal impaction was present.

Anesthesia and Analgesia

Anesthesia and pain management protocols were similar for all dogs. Dogs were anesthetized with a combination of dexmedetomidine, ketamine and butorphanol (DKT) mixed in equal proportions. Anesthesia was induced by an intramuscular (IM) injection of DKT at 0.06ml/kg. Cefovecina (8 mg/kg, SQ) and carprofen (4.4mg/kg, SQ) were administered to all dogs preoperatively. An endotracheal tube was placed, and anesthesia was maintained with isoflurane at 100% oxygen (1-2 l/min). Anesthesia was monitored by pulse-oximeter for the duration of the procedure.

Surgical technique

The skin of the perineum, scrotum and caudal aspect of the hind limbs were clipped and aseptically prepared. The rectum was digitally emptied, a gauze sponge was placed in the rectum and a temporary purse-string suture was placed around the anus. The dogs were positioned in dorsal recumbence for closed pre-scrotal orchietomy. A midline pre-scrotal incision was made over the cranially displaced testicle, into the subcutaneous tissue and the spermatic fascia, to allow exposure of the parietal vaginal tunic. The scrotal fat and fascia were stripped from the tunica, the spermatic cords were ligated, and the testicles were removed. The pre-scrotal incision was closed in two layers: both subcutaneous and intradermal layers were closed by simple continuous patterns (monofilament absorbable suture) and the skin was apposed with tissue glue.

The vaginal tunic was harvested from the testicle and opened along the greater curvature of the testis with Metzenbaum scissors (Figure 1). The tunic was placed between sterile gauze sponges and soaked with sterile ringer lactate solution until use.

Immediately after castration, dogs were placed in ventral recumbency with lightly elevated hindquarters, the hind limbs were hanging over the edge of the surgical table and the tail was secured in a cranial position (Figure 2). A dorsoventral skin incision was made over

the hernia, 1-2cm lateral to the anus, extending from the base of the tail to the midpoint between the ischial tuberosity and the pubis. The subcutaneous tissues were bluntly dissected until identification of the hernial sac. The hernial sac was incised and the herniated organs were identified and manually returned to anatomic position (Figure 3).

After the hernia was reduced, the perineal structures were identified: dorsolaterally, the coccygeous and levator ani muscles; laterally, the sacrotuberous ligament; medially, the rectum and external anal sphincter; and ventrally, the internal obturator muscle. The prepared tunica was placed into the hernial defect with 4 horizontal mattress sutures (2/0 - 3/0 monofilament nonabsorbable polypropylene), starting from the graft to the coccygeous, sacrotuberous ligament, periosteum of the ischial border and internal obturator muscle. Simple continuous sutures were placed between the simple interrupted sutures, including the tunica and the diaphragm muscles to keep the draft under tension, so as to keep the pelvic and abdominal viscera reduced and to support the rectal wall (Figure 4).

The subcutaneous tissue was closed over the graft using a simple continuous pattern (3/0 absorbable polyglycolic acid), and the skin was apposed with cruciate interrupted pattern (3/0 absorbable polyglycolic acid). Purse string was removed.

Postoperative evaluation

All dogs received buprenorphine (0.02mg/kg, IM, every 12 hours for 3 days) post-operatively for 3 days, carprofen (4.4mg/kg orally every 24 hours for 5 days) and lactulose (0.3ml/kg, PO, twice a day for 5-10 days). An Elizabethan collar was placed until suture removal. Follow-up information was provided by phone call. Attention was focused on post-operative clinical signs including difficulty to defecate, local pain, blood on the stools, diarrhea, surgical site dehiscence and infection and hernia recurrence.

Tunica vaginalis measurement

A parallel study was performed to correlate the dogs' weight with the tunica vaginalis size. Seventy-one random dogs from the shelter, that were presented for routine neuter, were included. Dogs were weighted prior to anesthesia induction. These patients followed the same anesthesia, analgesia and closed pre-scrotal orchietomy protocols as PH dogs. After the vaginal tunic was harvested from the testicle and opened along the greater curvature, the rectangular shape was measured in centimeter (length top, left bottom, width left and width right).

Results

A total of 10 dogs were diagnosed with PH in 2018 (12-month period). Seven sexually intact male dogs were included in the study, with a total of 8 perineal hernias repaired. Three dogs were excluded from the study, two of them were already neutered and one had complications during anesthetic induction and surgery was not performed. Median age was 9 years old (ranged from 8 to 12, average 9.57 ± 1.51). The median weight was 5kg (ranged from 3.6 to 34, average 14.64 ± 16.74). Six dogs had unilateral (5 left side hernias, 1 right side) and one dog had a bilateral PH. Clinical signs included perineal swelling (7), straining to defecate (7), constipation (3) and fecal impaction (3). Periprostatic fat and omentum (3), small intestine (2), and rectum deviation (4) were found in the hernias at the time of surgery. Dogs' outcome after surgery included return to owner via retention program (2), adoption (2) and rescue with further adoption (3).

All dogs left the shelter 12-24 hours after the surgical procedure. We recommended soft food diet and lactulose for 5 to 10 days. Follow-up time ranged from 9 to 17 months (average 12.14 ± 2.97). Clinical findings, hernia content and outcome for the 7 dogs included in the present study are summarized in Table 1. All dogs had excellent

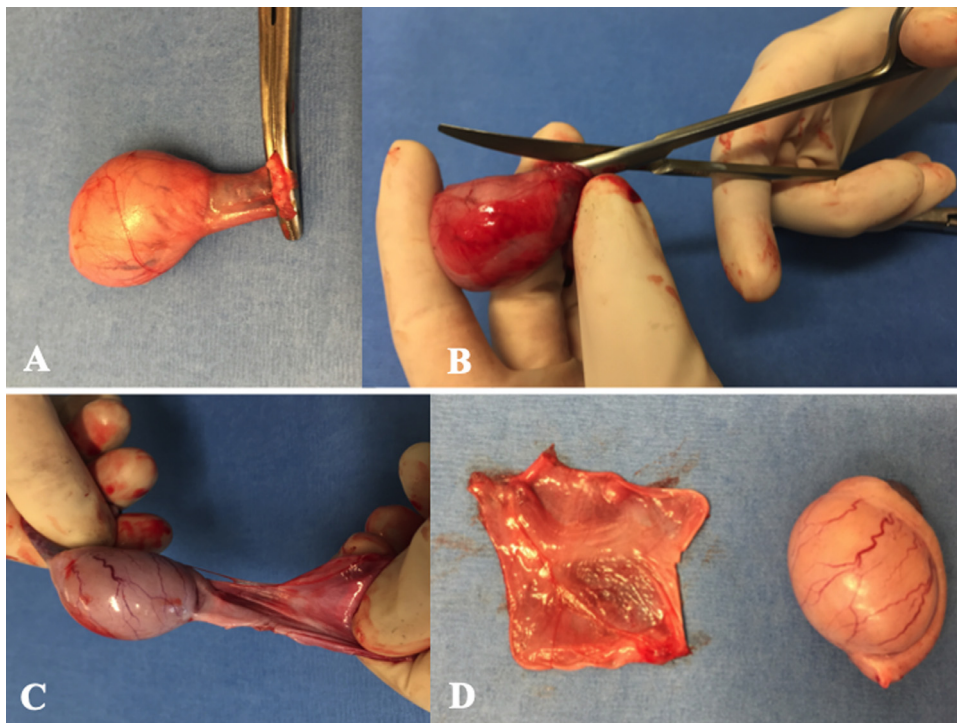


Fig. 1. After a closed castration (A), the tunica vaginalis communis was opened along the greater curvature of the testis with Metzenbaum scissors (B), it was harvested from the testicle (C) and a rectangular like shape was obtained.

outcomes. Two dogs presented difficulty to defecate, that was resolved a week after the surgery. The owners, rescue partners and adopters were aware that their pet had a PH repaired and informed that no surgical site complications and PH recurrence were observed.

Seventy-one dogs that had the tunica vaginalis harvest for measurement, were grouped by body weight (2 - 10 kg, 11 - 25 kg and 26 -

50 kg). Average weight and tunica vaginalis measurement are presented in [Table 2](#).

Discussion

Among the reasons for dog surrender or euthanasia at shelters are



Fig. 2. Dogs were placed in ventral recumbence with lightly elevated hindquarters, the hind limbs were hanging over the edge of the surgical table and the tail was secured in a cranial position.

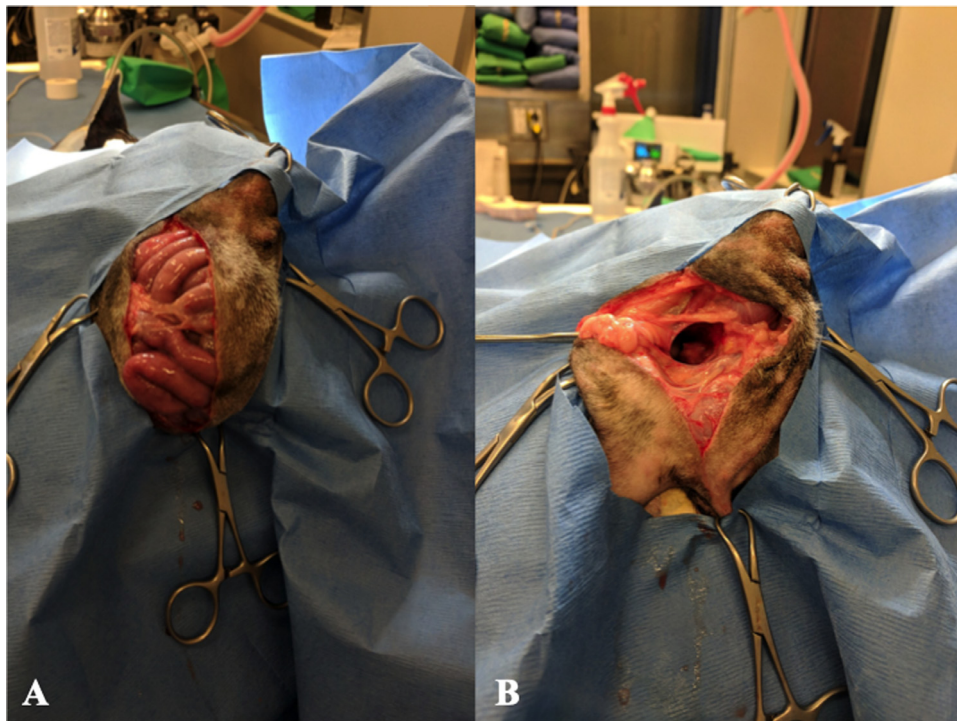


Fig. 3. Intraoperative view of the PH access. A dorsoventral skin incision was made over the hernia and the herniated organs were identified after the hernial sac was incised (A). After the hernia reduction, perineal structures were identified (B).

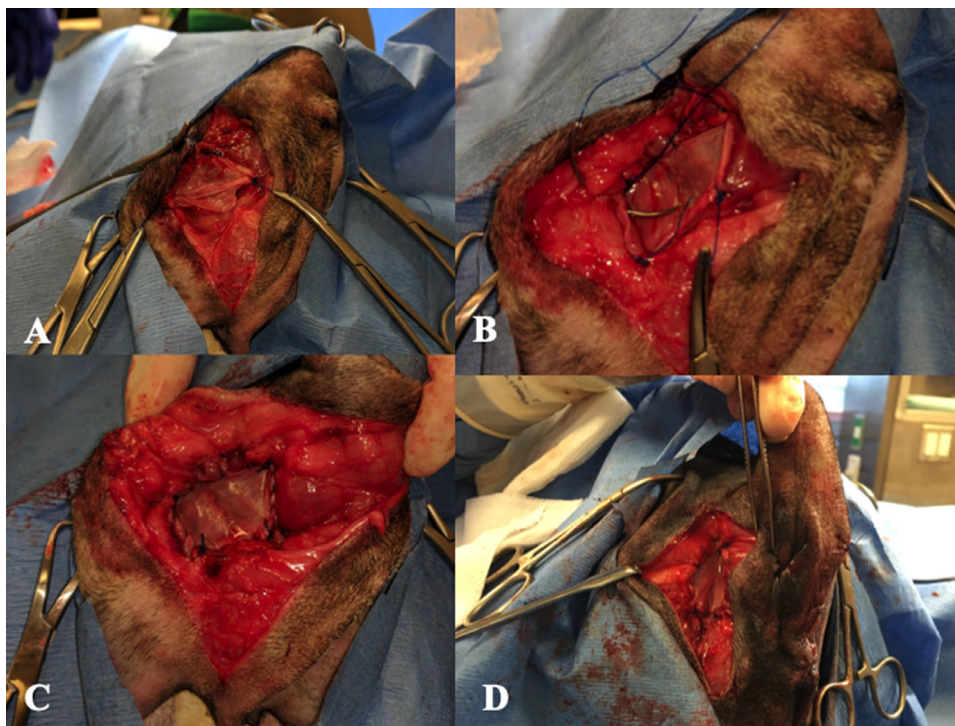


Fig. 4. The tunica vaginalis communis auto-graft was placed into the perineal defect by placing interrupted sutures between the tunica and the coccygeus and levator ani muscles (dorsolaterally), the sacrotuberous ligament (laterally) and the internal obturator muscle ventrally (A). A continuous simple suture pattern was placed between the interrupted sutures and would include the pelvic diaphragm and the graft (B). Final aspect of the graft under tension in a patient with a unilateral left side hernia (C) and a dog with bilateral PH (D).

medical conditions that are considered “demanding” of veterinary treatment (Lund et al. 2010; Lambert et al., 2015). The implementation of novel and attainable surgical techniques in the veterinary field reduces pet relinquishment and decreases euthanasia of dogs and cats. Some of these procedures often require a certain level of surgical training and expertise that will result in services not available to the pet caretakers seeking low-cost veterinary services.

Perineal hernias are frequently observed in intact mature male dogs.

Conditions requiring surgery are often the cause of pet relinquishment due to affordability of these procedures as well as the impact they have on the pet's quality of life when not appropriately treated. The present study demonstrates that by providing a reliable and affordable technique that requires less surgical expertise, will broaden the availability of this surgical procedure throughout veterinary practices, which might reduce pet relinquishment and euthanasia. In shelters, this technique will also increase the chances for a positive outcome and reduce the

Table 1

Clinical characteristics at presentation, intraoperative findings, patient outcome and follow up month of seven dogs repaired by autologous tunica vaginalis communis.

Dog	Age, Breed, Weight	Perineal hernia side	Clinical signs at presentation	Intraoperative findings (hernia contents)	Patient outcome	Follow up (months)*
1	8y, Rottweiler, 34kg	Left	Perineal swelling, dyschezia, constipation, fecal impaction	Rectum deviation	rescue	17
2	11y, Terrier mix, 6.3kg	Bilateral	Perineal swelling, dyschezia	Right side (Small intestines) Left Side (omentum, fat)	retention	14
3	12y, Terrier mix, 5.4kg	Right	Perineal swelling, dyschezia	Rectum deviation	retention	14
4	10y, Chihuahua, 4.5kg	Left	Perineal swelling, dyschezia	Small intestines, omentum, fat	rescue	11
5	9y, Yorkshire, 5kg	Left	Perineal swelling, dyschezia, constipation, fecal impaction	Rectum deviation	rescue	11
6	8y, Chihuahua, 3.6kg	Left	Perineal swelling, dyschezia	Omentum, fat, rectum deviation	rescue	11
7	9y, Terrier mix, 5kg	Left	Perineal swelling, dyschezia, constipation, Fecal impaction	Rectum deviation	rescue	11

Table 2

Dogs average weight (\pm standard deviation) and tunica vaginalis measurement (length and width; \pm standard deviation) after pre-scrotal castration.

Weight Group (kg)	Length top (cm)	Length bottom (cm)	Width left (cm)	Width right (cm)
6.31 (\pm 5.56)	5.26 (\pm 1.03)	5.13 (\pm 1.2)	4.77 (\pm 1.32)	4.76 (\pm 1.42)
17.92 (\pm 6.55)	6.96 (\pm 1.96)	6.68 (\pm 1.91)	5.71 (\pm 1.41)	5.86 (\pm 1.01)
31.89 (\pm 12.2)	10.24 (\pm 2.3)	9.52 (\pm 1.87)	8.47 (\pm 1.50)	7.97 (\pm 1.34)

length of stay (LOS) for shelter dogs. All dogs included in the study were adopted or returned to their owner via retention program.

The use of the autologous tunica vaginalis communis is an alternative in cases in which the internal obturator muscle is atrophied and is not viable to repair the perineal diaphragm, because it appears to have less postoperative complications such as infection rates than those reported with the use of synthetic mesh (Szabo et al., 2007). This technique also proved to be a technique that requires less surgeon expertise and is a suitable and low-cost alternative for PH repair in dogs. These characteristics make this technique a feasible alternative for use in low-cost settings such as shelters and nonprofit organizations, as well as private clinics and specialty practices. By using this technique, the pelvic diaphragm was strengthened, and the hernias were repaired without recurrence or major complications within 11-18 months.

Internal obturator muscle transposition is the conventional procedure for PH repair, although difficulties in restoring the pelvic diaphragm due to muscle atrophy (Shaughnessy and Monnet, 2015), surgeon inexperience (Sjollema and Van Sluijs, 1989; Marretta and Matthiesen, 1989; Orsher, 1989), and recurrence have been reported (Sjollema and Van Sluijs, 1989; Shaughnessy and Monnet, 2015). The treatment for PH with a lateral rectal sacculation has been successfully achieved with the transposition of internal obturator muscle, while a rectal ventral support has been effectively achieved by the semitendinous muscle transposition. The combination of both techniques can be used to provide lateral and ventral support with lower recurrence rate (Morello et al., 2015). The combination of these two techniques to repair the pelvic diaphragm is a complex and advanced surgical procedure that cannot be learned easily without proper surgical training and expertise, which creates a challenge to non-certified veterinary surgeons.

In this study, a free graft of the autologous tunica vaginalis communis was used to fill in the pelvic diaphragm. Various biomaterials have been used to repair PH, including fascia lata, canine small intestine submucosa and tunica vaginalis communis (Lee et al., 2012; Pratummintra et al., 2013; Guerios et al., 2017). Biomaterials are preferable over synthetic mesh materials, since fewer postoperative complications have been reported (Gill and Barstad, 2018). Advantages of the use of autologous tissue when reconstructing the pelvic diaphragm includes a reduction of foreign body reactions, postoperative seromas and wound infections. The tunica vaginalis communis originates from the peritoneum, and it is composed of mesothelium and connective

tissue (Wrobel, 1998). It has no antigenic properties (Pratummintra et al., 2013), thus has been experimentally used for reconstruction of urethral defects in rabbits (Atalan et al., 2005; Bongartz et al., 2005), abdominal wall defects in rats (Hafeez et al., 2005), umbilical hernias in sheep (Abass, 2008) and urinary bladder wall defects in dogs (Wongsetthachai et al., 2011). After implantation, neo capillaries and fibrous connective tissue from adjacent muscles will fill the graft (Pratummintra et al., 2013) thus strengthening the pelvic diaphragm.

There are few sources describing the use of tunica vaginalis communis to repair PH. One study reported the use of pedicle flap with the tunica in one dog (Tanaka et al., 2004), and a second study successfully reported the application of a free graft in 9 dogs (Pratummintra et al., 2013). Compared to the pedicle flap, the graft is less technical since the flap requires implantation into the perineal region via the abdominal cavity (Tanaka et al., 2004). Compared to the fascia lata graft, the tunica vaginalis communis does not require an additional surgical site, since routine castration is usually performed simultaneously with the PH repair (Pratummintra et al., 2013). Fascia lata grafts can be associated with donor site morbidity including seroma, hematoma, pain, wound dehiscence and lameness of the donor limb (Bongartz et al., 2005; Lambert et al., 2015). Castration performed at the time of the PH repair causes the prostate gland to atrophy within 2-3 weeks. Increased prostate size is related to constipation, which may result in rectal sacculation/diverticulum and PH recurrence (Hosgood et al., 1995; Snell et al., 2015; Hayashi et al., 2016).

Minor modifications of the technique previous described by Pratummintra (2013), were made to allow a faster and easier surgical procedure. The tunica was harvested and cut along the greatest curvature, achieving a rectangle shape. The longest side of the tunica was oriented dorsal to ventral to the pelvic diaphragm muscles and sutured. The decision was made not to cut the tunica in a triangle shape to account for the possibility of intense muscle atrophy and ensure coverage of the entire defect in every case. The graft was placed at the pelvic area with four (4) simple interrupted sutures. Subsequently, simple continuous sutures were placed between the previous interrupted sutures. The continuous sutures were intended to provide tension on the graft and to close any gaps between the sutures. These modifications allowed us to obtain a steady pelvic diaphragm and optimized surgical time. A polypropylene monofilament nonabsorbable suture material, was used for suturing, because it is relatively inert and provides strength for a

sustained period (Aronson, 2018).

The incorporation of the sacrotuberous ligament was considered primordial to achieve surgical success. The sacrotuberous ligament has a persistent stiffness and has the ability to replace the coccygeal muscle that in many of these cases is atrophied. Sciatic nerve entrapment has been described on PH repairs that include the sacrotuberous ligament (Khatri-Chhetri et al., 2016). In the present study, the ligament was penetrated instead of being encircled. Care was taken to place the needle close to the ischiatic attachment in order to avoid sciatic nerve damage. No patient presented sciatic nerve dysfunction during the follow up time.

An abdominal approach combined with the perineal repair had been recommended to treat bilateral and complicated PH. Colopexy, cystopexy and vas deferens pexy performed prior to the PH repair can reduce the risk of recurrence and facilitates herniorrhaphy (Brissot et al., 2004). In the present study, these techniques were not performed, since the anatomical reposition of the hernia contents were easily obtained during the PH repair and post operative recurrence was not observed.

To investigate the coverage capacity of the tunica vaginalis autograft we measured the size of the graft, after harvesting it from healthy dogs that were presented for neuter. We hypothesized that the size of the tunica is proportional to the dog weight and that would be adequate to cover the perineal defect. The observation that larger dogs (21 – 50 kg) presented with a considerably larger surface area when compared with smaller dogs (2 – 20 kg) did not affect surgical repair. The authors believe that the dogs' size does not restrict the correction of the PH with the tunica vaginalis, since we were able to successfully cover the perineal defect in all patients.

The age, sex and neuter status of affected dogs were consistent with previously studied populations (Hosgood et al., 1995; Snell et al., 2015; Aronson, 2018). In contrast with previous studies, most dogs were presented with left side PH (Bellenger, 1980; Brissot et al., 2004) and only one with bilateral PH. The proposed technique allowed the correction of one dog with bilateral PH, since we are able to harvest tunica from both testicles during castration. The suggestion that PH may be unilateral during physical exam should always be questioned, considering that the pelvic diaphragm weakness is generally bilateral. Correction of both sides should be considered, even when at the presentation clinical signs are apparently unilateral (Bernarde et al., 2018). Even though we only treated one dog bilaterally, we do recommend that PH should be treated as a bilateral disease regardless of its clinical presentation. Patients will benefit from systematic bilateral repair, since it may avoid further surgical procedures for PH repair.

Urinary disorders, tenesmus, persisting straining and rectal prolapse had been described as an early postoperative complication. Transient urinary incontinence and transient stranguria may be observed post-operatively, even in dogs that do not present dysuria before surgery (Brissot et al., 2004). All dogs in this study left the shelter with a rescue group, adopters or were returned to their owners 12 to 24 hours after the surgical procedure. Postoperatively, we were able to obtain clinical information via phone call, which included questions about post-operative complications, hernia recurrence and quality of life. A few post-operative complications were reported, mostly related with difficulty to defecate that was resolved after 2-3 days. One of the limitations of this study was the inability to perform live post-operative physical exams on the patients instead of via a telephone questionnaire 9-12 months after the procedure; thus, limiting the early postoperative follow up. Recurrence is a complication that can occur early or later (> 6 months after the initial surgical procedure) (Snell et al., 2015). The mean follow-up time of 12 months was adequate to demonstrate the long-term efficacy of the autologous tunica vaginalis communis graft technique.

Conclusions

The seemingly invasive nature of the surgical procedure to repair PH

may interfere with the veterinary doctors' decision to not treat this disorder. This decision may have variable impacts on the animal outcome, leading to animal relinquishment and in some cases euthanasia. The most suitable technique to prevent or treat PH will rely on surgeon's ability and experience. We demonstrated that the surgical treatment of PH with autologous tunica vaginalis communis graft is a low-cost procedure, that requires minimal surgical training and expertise which allows adequate filling of the pelvic diaphragm defect, providing sufficient perineal strength to avoid recurrence.

Declaration of Competing Interest

None of the authors has any financial or personal relationships that could inappropriately influence or bias the content of the paper.

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