UNIVERSITI PUTRA MALAYSIA

A RETROSPECTIVE STUDY OF INDICATIONS FOR AND OUTCOME OF URETHROSTOMY IN CATS AND DOGS PRESENTED TO UNIVERSITY VETERINARY HOSPITAL, (UVH), MALAYSIA FROM 2010 TO 2015

TAN JIA YAN

A RETROSPECTIVE STUDY OF INDICATIONS FOR AND OUTCOME OF URETHROSTOMY IN CATS AND DOGS PRESENTED TO UNIVERSITY VETERINARY HOSPITAL, (UVH), MALAYSIA FROM 2010 TO 2015.

TAN JIA YAN

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It is hereby certified that we have read this project paper entitled "A Retrospective Study of Indications for and Outcome of Urethrostomy in Cats and Dogs Presented to University Veterinary Hospital (UVH), Malaysia from 2010 to 2015", by Tan Jia Yan and in our opinion it is satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the course VPD 4999-Final Year Project.

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Specially dedicated to my family, friends, and the special one that I love

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LIST OF ABBREVIATIONS

PU	Perineal Urethrostomy
PPU	Prepubic Urethrostomy
SU	Scrotal Urethrostomy
PSU	Prescrotal Urethrostomy
UVH	University Veterinary Hospital
UPM	University Putra Malaysia
FLUTD	Feline Urinary Tract Disease
UTI	urinary tract infection
ILUTD	Idiopathic Lower Urinary Tract Disease
SPSS	Statistical Program for Social Science
%	percentage

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ABSTRAK

Abstrak daripada kertas projek dikemukan kepada Fakulti Perubatan Veterinar bagi memenuhi sebahagian daripada keperluan kursus VPD 4999-Projek.

KAJIAN RETROSPEKTIF BERKAITAN DENGAN INDIKASI DAN KOMPLIKASI URETHTROSTOMY DALAM KUCING DAN ANJING YANG DIPERSEMBAHKAN DI HOSPITAL VETERINAR UNIVERSITI (UVH), MALAYSIA, DARI TAHUN 2010 HINGGA 2015.

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Penyelia: Dr. Rozanaliza Radzi

Urethrostomy merupakan satu prosedur pembedahan untuk menciptakan satu stoma yang kekal untuk urethral. Objektif kajian ini adalah untuk mengenalpasti indikasi dan hasil urethrostomy dalam kucing dan anjing yang dipersembahkan ke Hospital Veterinar Universiti (UVH), Malaysia dari tahun 2010-2015, Selain itu, tujuan kajian ini juga untuk mengenalpasti kelaziman mengenali hasil dan komplikasi di sebabkan oleh urethrostomy yang dijalankan di kucing dan anjing di UVH dari 2010-2015. Sebanyak 20 kes yang telah menjalankan pembedahan urethrostomy telah dikenalpasti daripada rekod UVH dan daripada 20 kes ini, 17 kes terdiri daripada kucing, malah 3 kes anjing. Rekod perubatan tentang kes seperti signalment pesakit,

tanda-tanda klinikal, diagnostik informasi, jenis pembedahan, komplikasi selepas urethrostomy dan reaksi rawatan. Indikasi yang paling biasa mengenai urethrostomy dalam kucing ialah urethral rupture(59%), urethral stenosis(29%), urolithiasis(6%) dan urethral fistula(6%). Indikasi untuk urethrostomy dalam anjing ialah urolithiasis(67%) dan urethral stenosis (33%). Komplikasi selepas urethrostomy dalam kucing adalah seperti urine burn(29%), lebam(12%), seroma(12%), euthanasia atau mati(12%), pendarahan(6%) dan granulomatous pada pembukaan urethral(6%). Daripada 3 ekor anjing, semua anjing menunjukkan pendarahan(100%) selepas urethrostomy dan salah satu daripada mereka mempunyai lebam pada lokasi pembedahan(33%). Selain itu, kebanyakan kucing(47%) dan anjing(100%) menunjukan hasil yang bagus terhadap pembedahan. Walau bagaimanapun, 29% kucing telah memulih daripada masalah utama tetapi mempunyai komplikasi seterusnya, 12% kucing telah dieuthanasia ataupun mati dan 12% kucing lagi tidak dapat dinilai disebabkan oleh jangka masa menilai yang singkat.

Kesimpulannya, kajian ini menunjuk bahawa hasil terhadap Uretrostomy oleh kucing dan anjing adalah bagus walaupun terdapat komplikasi yang berlaku tetapi pulih dalam beberapa hari selepas pembedahan.

Kata Kunci: Urethrostomy, Kucing, Anjing, Hospital Veterinar Universiti, Indikasi

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfillment of the course VPD4999-Project

A RETROSPECTIVE STUDY OF INDICATIONS FOR AND OUTCOME OF URETHROSTOMY IN CATS AND DOGS PRESENTED TO UNIVERSITY VETERINARY HOSPITAL (UVH), MALAYSIA FROM 2010 TO 2015.

BY

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Urethrostomy is the creation of a permanent stoma into the urethra when permanent diversion of urine flow proximal to an obstruction, site of narrowing, severely damaged, destruction, or disease urethra is required. The objectives of this study were to identify the indications for and outcome of urethrostomy in cats and dogs; and to determine the prevalence of complications post urethrostomy in cats and dogs presented to University Veterinary Hospital (UVH), Malaysia from 2010-2015. A total of 20 urethrostomy cases were identified in this study (17 cats and 3 dogs). Patients' clinical data were retrieved and reviewed for signalment, clinical presentation, diagnostic investigation, surgical approaches, complications occurred post-urethrostomy and response to treatment. The most common indication for

urethrostomy in Feline group was urethral rupture (59%), followed by urethral stenosis (29%), urolithiasis (6%) and urethral fistula (6%). Indications for urethrostomy in Canine group were urolithiasis (67%) and urethral stenosis (33%). Complications post-urethrostomy in cats included urine burn (29%), bruises (12%), seroma (12%), euthanized or died (12%), hemorrhage (6%) and granulomatous lesion at urethral opening (6%). All dogs showed hemorrhage (100%) after urethrostomy and one of them had bruises at surgical site (33%). All dogs and 47% of cats showed good response to surgical treatment, while 29% of the cats had primary problem solved with occurrence of complication, others were euthanized or died, or unable to be assessed. This study showed that overall response to urethrostomy in cats and dogs were good despite some immediate complications.

Keyword: Urethrostomy, cats, dogs, University Veterinary Hospital, indications

1.0 Introduction

Urethrostomy is the creation of a permanent stoma into the urethra (Yool, 2012) when permanent diversion of urine flow proximal to an obstruction, site of narrowing, severely damaged, destruction, or disease urethra is required.

Recommended sites for urethrostomy differ between cats and dogs due to anatomical differences between animal species (Mary, 2011). There are four approaches of urethrostomy that can be done in cats which are perineal, prepubic, subpubic and transpelvic urethrostomy. Anatomical approaches of urethrostomy common in dogs are prescrotal, scrotal, perineal or prepubic depending on the site of the lesion (Monnet, 2013; Fossum, 2002).

Perineal urethrostomy is performed most frequently in cats that suffer from recurrent urethral obstruction due to lower urinary tract disease. However, perineal urethrostomy in dog is more difficult to be performed as the perineal urethra does not prominently sit in a subcutaneous position and it may result in urine scalding if the dog urinates onto its medial thigh (Bjorling, 2003).

Scrotal urethrostomy is preferred in male dogs as the urethra is wider, more distensible, more superficial and surrounded by less cavernous tissue thus incision at this location is associated with less hemorrhage (Monnet, 2013; Bjorling, 2003; Smeak, 2000). Prescrotal urethrostomy is also generally performed in male dogs in general practice but scrotum limits the length of incision that can be made.

Urethrostomy is a salvage procedure and the functional state of the urethra should be the basis of the decision to perform the surgery (Little, 2012). Indications for urethrostomy are recurrent urethral obstruction, urethral

obstruction that cannot be relieved by catheterization and retro-hydropropulsion, urethral rupture, urethral stricture and neoplasia (Smith, 2002). Urethral obstruction had been reported in 58% of cats with Feline Lower Urinary Tract Disease (FLUTD) (Gerber *et al*., 2005) while 35% of cats had experienced recurrence of urethral obstruction within six months after obstructive FLUTD (Bovee *et al*., 1979).

Complications reported after surgery included urinary tract infection, stricture formation, post-operative urine leakage, incisional hemorrhage, urine-scald dermatitis and urinary incontinence (Langley, 2014; Monnet, 2013). The prevalence of specific complications may vary with the anatomical location of the urethrostomy site (Mary, 2011). However, some studies revealed that patients may experience early or late complications after urethrostomy but majority of the clients considered their cats and dogs to have good quality of life (Ruda *et al*., 2012; Burrow *et al*., 2011; Bass *et al*., 2005).

The outcome of urethrostomy is affected by the surgical technique such as preservation of striated muscle in the urethral sphincter (Ruda *et al*., 2012) and preservation of the urethral branches of the pudendal nerve during urethrostomy (Bjorling, 2003). Besides, a higher incidence of bacterial cystitis had been attributed to excessive dissection of the intrapelvic urethra resulting in damage to the innervation and facilitating ascending bacterial infection. In general, surgeon's knowledge, experience and skill are very important and will greatly impact the outcome of the surgery.

This study allows us to have better understanding of the common indications for urethrostomy in cats and dogs in University Veterinary Hospital (UVH),

Malaysia and the common outcome after surgery. The impact of this study is to assist clinicians in making clinical decision to perform this operation and the risk of each possible outcome

Objectives of this retrospective study are to identify the indications for and outcome of urethrostomy in cats and dogs presented to University Veterinary Hospital (UVH), Malaysia from 2010-2015. We hypothesize that urethrostomy is commonly indicated in cats and dogs with urethral obstruction which catheterization approach or medical treatment fail and there are a number of immediate complications reported after urethrostomy but the majority of animals have a good quality of life post-operatively.

The objectives of this study are:

1. To identify the indications for and outcome of urethrostomy in cats and dogs presented to University Veterinary Hospital (UVH), Malaysia from 2010-2015.
2. To determine the prevalence of complications as a result of urethrostomy in cats and dogs presented to University Veterinary Hospital, Malaysia from 2010-2015.

2.0 Literature Review

2.1 Urethrostomy

Urethrostomy is creation of a permanent stoma into the urethra (Yool, 2012) when permanent diversion of urine flow proximal to an obstruction, site of narrowing, severely damaged, destruction, or disease urethra is required. It is to allow urine flow around an irreversibly diseased or damaged urethra (Smeak, 2000). This procedure is also performed to diminish the risk of recurrent urinary calculi obstruction that most likely cannot be resolved through medical therapy (Monnet, 2013; Fossum, 2002; Smeak, 2000). The main goal of urethrostomy is to reestablish urethra patency. (Monnet, 2013; Smeak, 2000) Urethrostomy can be further subdivided into different types depend on the site of the problem which occur at the urethral, which include perineal urethrostomy (PU), prepubic urethrostomy (PPU), subpubic urethrostomy (SPU), transpelvic urethrostomy (TPU), prescrotal urethrostomy(PSU), scrotal urethrostomy (SU) (Langley, 2014; Bernarde *et al.*, 2004; Fossum, 2002).

2.1.1 Perineal Urethrostomy (PU)

Perineal urethrostomy is a surgical procedure to create a permanent opening between the pelvic urethra and the skin in the perineal region (Langley, 2014; Smith, 2002). It is a common approach of urethrostomy done in cats. This procedure is performed for severe recurrent lower urinary tract disease or obstructed calculi that cannot be managed medically (Langley, 2014; Ruda *et al.*, 2012). There was study showing that around 28.6% to 58% of urethral obstruction in cases of Feline Urinary Tract Disease (FLUTD) while cases with recurrence within 6 month were between 22% to 35% (Westropp *et al.*, 2010; Bovee *et al.*, 1979). This showed that PU was an alternative approach in the managing of recurrent cases of obstructive FLUTD.

However, studies also revealed that surgical treatment does not eliminate the recurrence of FLUTD or urinary tract infection (UTI) (Ruda *et al.*, 2012). However, this approach is not commonly used in dogs as it is more complicated to be performed and may often lead to chronic urine scald dermatitis (Smeak, 2000).

2.1.2 Prepubic Urethrostomy (PPU)

PPU, which is also known as antepubic urethrostomy is performed in both male and female cats and dogs with irreparable obstruction of the intrapelvic urethra (Baines *et al.*, 2001; Carb *et al.*, 1982). It is a salvage procedure in which pelvic urethra is made to exit the ventral abdominal area when others more distal urethrostomy such as perineal urethrostomy or scrotal urethrostomy cannot be performed (Smeak, 2000).

2.1.3 Scrotal Urethrostomy (SU)

Scrotal urethrostomy is only performed in dogs but not in cats and it is the most common approach in dogs (Monnet, 2013). It is preferred site of urethrostomy in male dogs because the membranous urethra in the region of scrotum is wider and more distensible and is surrounded by less cavernous tissue thus incision at this location is associated with less hemorrhage (Monnet, 2013; Smeak, 2000; Bilbrey, 1991; Newton *et al.*, 1996). The scrotal urethra is approached by an incision around the base of the scrotum in a castrated dog or through castration and scrotal ablation in an intact dog (Monnet, 2013). Thus, it is necessary to obtain owner's consent for castration before attempting SU. However, it cannot be performed in cases that the obstruction site is more proximal (Daniel, 2000).

2.1.4 Prescrotal Urethrostomy (PSU)

Prescrotal urethrostomy is usually not recommended as patient may have higher risk to experience post-operative complication such as urine burn (Daniel,

2000). The approach to urethra is similarly to prescrotal urethrotomy which a ventral midline incision is made between the caudal aspect of the os penis and scrotum (Fossum, 2002).

2.2 Indications for Urethrostomy

2.2.1 Indications for Perineal Urethrostomy (PU)

Perineal urethrostomy is rarely performed in dogs and it is only being considered when the urinary problems in dogs cannot be solved through a scrotal urethrostomy (Fossum, 2002). Indications for PU in dogs include severe damage, stricture or obstructed urethra at more proximal site compared to the site of scrotal urethrostomy (Smeak, 2000). In cats, it is normally performed in cases of recurrent obstructive FLUTD whereby the obstructive calculi cannot be resolved by medical and nutritional approach such as catheterization with or without retro-hydropropulsion (Langley, 2014; Monnet, 2013; Corgozinho *et al.*, 2007). Other indications in cats whereby PU is to be carried out include stricture or trauma of the penile urethra due to post catheterization or neoplasia (Langley, 2014). The rationale of PU is to remove the narrow penile urethra and create a stoma in the wider postprostatic or pelvic urethra (Langley, 2014). One report showed that the most common indication of PU in cats was stricture of the perineal stoma (Marry, 2011).

2.2.2 Indications for Prepubic Urethrostomy(PPU)

Prepubic urethrostomy or antepubic urethrostomy is performed in both male and female cats and dogs with irreparable obstruction of the intrapelvic urethra caused by uroliths, urethral stricture, urethral tumors, and granulomatous urethritis, pelvic urethral rupture, salvage of failed perineal urehtrostomy and the presence of a perineal skin deficit that prevent PU from being performed (Monnet, 2013; Baines *et al.*, 2001).

One of the studies showed that major indications for PPU in cats were stenosis of a previous PU or obstruction of the pelvic urethra secondary to Idiopathic Lower Urinary Tract Disease (ILUTD) (Baines *et al.*, 2001).

2.2.3 Indications for Scrotal Urethrostomy (SU)

Scrotal urethrostomy is normally carried out in dogs with recurrent urethral calculi obstructions that are not responsive to appropriate medical therapy, severe distal urethral wounds secondary to penile or os penis trauma, urethral stricture distal to the scrotum from trauma or previous urethral surgery, disease such as neoplasia, penile strangulation, priapism, congenital severe hypospadias and deficiency in penile or preputial length that require amputation of the penis or prepuce and formation of a more proximal urethral stoma (Daniel, 2000). It is preferred over perineal or prepubic urethrostomy because the urethra is wider, more superficial and surrounded by less cavernous tissue than the other sites (Fossum, 2002).

2.2.4 Indications for Prescrotal Urethrostomy

Prescrotal urethrostomy is used to remove calculi from the distal penile urethra usually obstruction at os penis and the indication is about similar to scrotal urethrostomy depend on the location of the urethral obstruction (Fossum, 2002; Daniel, 2000). However, it is usually not recommended as urine often becomes misdirected and may lead to complication. It is considered when castration is objectionable to the owner or the obstruction site is more proximal (Daniel, 2000).

2.3 Surgical Technique

2.3.1 Surgical Technique in Perineal Urethrostomy

There are several different techniques of performing PU. In traditional method introduced by Wilson and Harris (Wilson *et al.*, 1971), the cat is positioned in either dorsal or sternal recumbency with the hind limbs extended over the edge of the table and the tails tied over the body. The perineum including 4-5cm at the ventral base of the tail is clipped and scrubbed aseptically. A purse-string suture is applied to the anus and avoiding the anal sacs. A urinary catheter can be placed if possible to allow the identification of the urethra. An elliptical incision is made around the scrotum, prepuce and penis leaving at least 1cm of skin between the anus and the proximal extent of the incision. Sufficient skin is removed at the base of the scrotum and prepuce to permit slight tension on the skin-urethra anastomosis so that the skin edges do not roll inward and make contact.

Blunt dissection is done carefully to isolate the penis and the ischiocavernous and ischiourethralis muscles. The ventral penile ligament is severe and the ischiocavernosus as well as ischiourethralis muscle were transected at their ischial attachments to minimize hemorrhage as well as to avoid damaging the branches of the pudendal nerves. Adequate mobilization is accomplished by blunt dissection ventrally and digital elevation of the penis and pelvic urethra from the pelvic floor. The retractor penis muscle, bulbocavernous muscle and bulbourethral glands are identified and the retractor penis muscle is elevated, transected near the external anal sphincter muscle and removed to the level of the bulbourethral glands. Care should be taken in this dissection to prevent damage to the rectum and pelvic nerve.

A longitudinal incision is made into the urethra on its dorsal surface from the tip of the penis with iris scissors and extended to the bulbourethral glands. The diameter of the pelvic urethra at the level of bulbourethral glands is approximately 4mm which a pair of closed mosquito hemostat forceps can be introduced until its box-locks. The urethral mucosa of incised pelvic urethra and around two thirds of the penile urethra were sutured to the skin with 4-0 monofilament absorbable or non-absorbable suture materials by using simple interrupted suture patterns. The remaining penile urethra distal to the PU site was removed and the incision site was closed. Indwelling urinary catheter after surgery should be avoided due to the risk of stricture formation and ascending urinary tract infection (Wilson *et al.*, 1971).

2.3.2 Surgical Technique for Prepubic Urethrostomy (PPU)

The animal is placed in dorsal recumbency. A ventral midline incision is made from the umbilicus to the pubis. Urethra is mobilized and free from the pelvic floor by using blunt dissection. Urethral artery, it branches and pudendal nerve are preserved carefully. In some male dogs, it may be necessary for prostate to be dissected from the urethra to ensure that there is ample urethra to exteriorize to the skin without undue tension. The most distal part of healthy urethra is ligated and urethra is transected just cranial to the ligature so that as much urethral length as possible is preserved.

A stay suture was placed in the distal aspect of the urethra to minimize tissue handling. Urethra was brought through a stab incision located 2 to 3 cm lateral to the prepuce or within the prepuce (in male dog) or through the ventral midline incision or 2 to 3cm lateral to the linea alba. Ensure that there is little tension on the PPU site and the urethra is not kinked as it passes through the abdomen to the skin. Exteriorization of urethra that is too far forward may cause a sharp bend in the urethra which may

compromise outflow of urine. 4-0 polydioxanone sutures can be made between the ventral rectus fascia and the periurethral tissue to limit tension on the primary suture line. The ventral midline incision is closed routinely. The distal end of the urethra is spatulated prior to suturing to increase the luminal diameter. Urethra mucosa is sutured to the skin with simple interrupted suture pattern with monofilament absorbable or non-absorbable suture materials. In dogs, anastomosis of the urethra to the preputial mucosa has been recommended to reduce urine contact dermatitis. (Fossum, 2002; Daniel, 2000).

2.3.3 Surgical Procedure for Scrotal Urethrostomy

The dog is placed on dorsal recumbency. Scrotal ablation is performed by making an elliptical skin incision around the base of the scrotum and performing castration in routine manner if the dog is sexually intact. A sterile urinary catheter is placed to the level of the ischial arch or beyond it. Retractor penis muscles are exposed by making a midline incision through the subcutaneous tissue, mobilized and retracted laterally to expose the urethra. The urethra is incised sharply on ventral midline for 3 to 4cm length (around five to eight times the diameter of urethra) with a no.15 scalpel blade to ensure sufficient urethral lumen size for healing as the opening will be around two thirds to one half of the original length. Urethral mucosa is sutured to the skin, starting at the caudal aspect of the incision, by using simple interrupted suture pattern with absorbable or non-absorbable suture materials. (Fossum, 2002; Daniel, 2000).

Modified SU technique by using a continuous suture pattern and a three-needle bite sequence for urethrostomy closure is introduced by Newton and Smeak to reduce hemorrhage after surgery (Newton *et al.*, 1996).

2.3.4 Surgical Procedure for Prescrotal Urethrostomy

The dog is placed in dorsal recumbency with a sterile urinary catheter placed into the penile urethra to the scrotum or beyond it. A ventral midline incision is made through the skin and subcutaneous tissue, between the caudal caudal aspect of the os penis and scrotum. Retractor penis muscle is exposed, mobilized and retracted laterally to expose the urethra. A 3 to 4cm ventral midline incision is made in the urethral mucosa (the length of the urethral incision should be five to eight times its luminal diameter as described in SU surgical technique). Urethrostomy closure is performed as described in SU surgical technique. (Fossum, 2002; Daniel, 2000).

2.4 Complication of Urethrostomy

2.4.1 Complication of Perineal Urehtrostomy (PU)

2.4.1.1 Cats

The most frequent post-operative complication observed is bacteria urinary tract infections (UTI). Studies revealed that between 17 to 57% of cats that undergone for perineal urethrostomy had developed UTI (Bass *et al*, 2005; Griffin *et al*, 1992; Smith *et al*, 1978). It is possible that the increased prevalence of bacterial UTI in cats after PU is partly attributable to the underlying disease process producing obstructive uropathy, shortening the functional length of the urethra, loss of penile urethral mucosal defence mechanisms, increased diameter of external urethral orifice, impaired striated urethralis muscle function, decreased intraluminal pressure, concomitant disease in remaining portion of urinary tract and transurethral catheterization (Smeak, 2000; Osborne *et al*, 1996; Griffin *et al*, 1992). Moreover, one of the studies mentioned that the one of the most commonly reported postoperative complication for PU was stricture of the perineal stoma (McLoughlin, 2011; Bass *et*

al, 2005; Smith *et al*, 1978). The cause of the stricture can be due to inadequate dissection of the urethra to the level of the bulbourethral glands, failure to disrupt or sever the pelvic attachments of the penile urethra that prevents adequate mobilization of the urethra and excessive tension at the stoma (Mary, 2011). Other than that, one of the complications of the PU is urolithiasis if urinary tract infection that is caused by *Staphyloccocus sp*. (such as *Staphyloccocus intermedius*) has developed and further lead to the formation of infection induced struvite urocystoliths (Osborne *et al.*, 1996). The formation of the urocystoliths may further cause hematuria and dysuria (Osborne *et al.*, 1996). Furthermore, other reported complication includes hemorrhage from cavernous tissues because the urethra is surrounded by cavernous tissue (Smith, 2002). Other less frequently reported complications of PU include urine leakage into the perineal tissue and urinary incontinence (Smith, 2002). Urinary incontinence may occur as a result to overdistention of the urinary bladder during the obstruction episode or due to the damage to the pudendal nerve during surgery (Smith, 2002).

2.4.1.2 Dogs

In dogs, there was study reported that PU could increase the risk of urinary tract infection due to shortening the functional length of the urethra, as described in the complication of PU in cats. Moreover, there were also reported cases of urine scalding around the urethrostomy site if proper postoperative care was not done (Smeak, 2000). Minor hemorrhage had also been reported but profuse bleeding from the PU stoma was rare (Smeak, 2000). Leakage of urine into the subcutaneous tissue may be suspected if there is any swollen, bruised and painful area of the skin surrounding the PU site. However, urinary incontinence is not a major problem because the procedure is distance from urethral sphincter area in PU (Smeak, 2000).

2.4.2 Complication of Prepubic Urethrostomy(PPU)

2.4.2.1 Cat

For the surgical procedure of PPU in cats, the reported complications in cats included urinary incontinence, subcutaneous infiltration with urine, urinary incontinence, stricture of the urethral stoma, bleeding from the exposed urethral mucosa, recurrent lower urinary tract infection, chronic urine-scald dermatitis, and kinking of the urethra (Smith, 1993; Stone *et al.*, 1992). A study which followed the PPU cat postoperatively for few weeks showed that up to 60% of the cats developed complication which required veterinary attention while another study reported that 33% of the cats developed urinary tract infection (Baines, 2001). The complication in PPU is similar to PU, but they are less common and the long-term results are better with PU than PPU (Baines, 2001).

Other than that, peristomal skin irritation, dermatitis and skin necrosis were also reported as complications of PPU (Baines *et al.*, 2001). Peristomal skin irritation is associated with marked urinary incontinence, mild dermatitis is usually presented immediately postoperatively while peristomal skin necrosis is usually developed several months postoperatively (Baines *et al.*, 2001). Urine scald dermatitis was also reported in several studies in immediate postoperative period which could be due to redirection of urine flow with maintenance of a normal posture during micturition and subsequent splashing of urine around the urethral stoma (Baines *et al.*, 2001; Stone *et al*., 1992). Interdigital dermatitis was also reported in obese cat due to pendulous skin folds that were contaminated with urine (Baines, 2001).

Furthermore, in one of the studies, subcutaneous infiltration of urine around the stoma associated with dehiscence of the wound was reported in 4 out of 32 cats in

the first few days after PPU (Bernarde *et al.*, 2004). It may be occurred as a sequel of leakage around the stoma or iatrogenic lacerations of the urethra. Besides, dribbling of urine from the stoma immediately post-urethrostomy had also been reported (Baines *et al.*, 2001). Incontinence may be arose from shortening of the urethra, damaging to the nerves supplying the bladder and urethra (either as a result of surgery or from the original traumatic incident) and urge incontinence due to chronic urinary tract infection (Baines *et al.*, 2001). Incontinence associated with PPU was reported more frequently than those associated with PU (Kyles *et al.*, 1996; Smith *et al.*, 1978). Moreover, stricture following PPU had been described which could be due to the use of indwelling catheter, licking at the surgical site, lower urinary tract infection, traumatic handling of the tissues, poor mucosa to skin apposition, failure to mobilize the urethra to provide a tension-free stoma and failure to incise the urethra to the level of the wider pelvic urethra (Baines, 2001; Smith, 1993). However, it was not reported in another study which could be due to urethra involved during PPU had wider diameter and the intra-abdominal portion of the urethra was easier to be mobilized than the intrapelvic and perineal part (Baines *et al.*, 2001).

2.4.2.2 Dogs

For PPU in dogs, the complications are about similar to cats which include peristomal dermatitis, inflammation and maceration of the peristomal skin, and ascending urinary tract infection which may further lead to heamaturia, stranguria and pollakiuria (McLoughlin, 2011). Other than that, urethral obstruction may occur if the position of the stoma results in an acute angle in the urethra relative to the bladder neck (Bjorling, 2003). Elizabethan collar should be placed on all dogs with PPU in

order to prevent licking of incision site which further cause suture break down or UTI (Smeak, 2000).

2.4.3 Complication for Scrotal Urethrostomy (SU)

The complications for scrotal urethrostomy in dogs postoperatively include hemorrhage when simple continuous closure is used (McLoughlin, 2011). Another study also reported that intermittent hemorrhage from the SU site occurred during or immediately after urination and lasted for 3 to 21 days postoperatively (Burrow *et al.*, 2011). Moreover, urinary tract infection was also one of the reported SU complications post operatively (Burrow *et al.*, 2011). Other minor complications were recorded such as mild swelling and bruising of the urethrostomy site, granulation tissue at the cranial edge of the stoma, wound dehiscence and stricture of the SU site (Burrow *et al.*, 2011). Furthermore, other possible complication includes subcutaneous leakage of urine which further causes cellulitis or scald of the local tissues (Bjorling, 2003; Kyles *et al.*, 1996).

2.4.4 Complication for Prescrotal Urethrostomy (PSU)

There are limited studies on the prescrotal urethrostomy in dogs as it is not a preferable urethrostomy surgery in dog and it is not commonly performed. This is because it tends to cause stricture more easily than other types of urethrostomy such as SU (Daniel, 2000). Only one study reported that the complications of prescrotal urethrostomy included leakage of urine into the scrotum, which may lead to cellulitis and haemorrhage at un-sutured incision site as well as painful erection and ejaculation postoperatively (Harari, 2004). It is not recommended because the urine expelled from the urethrostomy stoma often becomes misdirected and cause soil to the skin of scrotum, inguinal region, and medial thighs (Daniel, 2000).

3.0 Material and Methods

3.1 Data Collection

A retrospective study was performed on the records available in University Veterinary Hospital (UVH) of University Putra Malaysia, Malaysia, for a period of 6 years from January 2010 to December 2015. Log books were screened through and records on urethrostomy in cats and dogs were included. Case numbers of the respective cases were obtained and medical and surgical records were retrieved and reviewed for patient signalment, clinical presentation, diagnostic investigation, medical treatment, types of surgical approach, complications that occurred post-urethrostomy and response to treatment.

Data on patient signalment that were retrieved include patient ID, age, breed, gender, neuter status, management (diet, multi- or single animal household, indoors or outdoors), date of presentation and date of surgery performed. These patients were categorized into ages of less than one year old as young cats or young dogs and equal or more than one year old as adult cats or adult dogs. According to neuter status, patients were also categorized into castrated male, intact male, spayed female and intact female.

Historical data were noted for any information on previous history of illness and the respective treatment done. The observed clinical signs in affected patients and the diagnostic reports such as complete blood count (CBC), serum biochemistry profiles, urinary analysis, bacterial culture (from urine sample), ultrasonography examination, radiography examination and contrast study were also recorded. Indication for urethrostomy being performed in each case was recorded in this study

and grouped into four categories which were urethral rupture, urethral stenosis, urolithiasis and urethral fistula.

Medical and surgical data were obtained including pharmaceutical drugs used, urinary catheterization, cystocentesis and types of urethrostomy performed. Complications occurred after urethrostomy were reviewed which were urine burn, harmorrhage, bruises, seroma and granulomatous lesion at urethral opening. Patients' response to urethrostomy were categorized into four categories which were good, primary problem solved with complication, unable to be assessed due to short follow-up period (less than 7days) and euthanized or died.

3.2 Data Tabulation and Statistical Analysis

All data were tabulated in the Microsoft Excel spreadsheet and transferred to the SPSS (Statistical Program for Social Science) spreadsheet for further analysis. All statistical analyses were conducted by using the IBM SPSS software version 20.0. Additional tests for association using the Chi-Square (Fisher's exact test) were performed on selected data. Statistical significance was recorded at $p<0.05$ which the level of significance was set at 5%. Selected factors that were used to determine the association test were species, age, sex, neuter status, clinical presentation, indications for urethrostomy, complications post-urethrostomy and patient's response to treatment.

4.0 RESULTS

Records were available for 20 patients which including 17 cats and 3 dogs that had undergone urethrostomy during the study period which was from January 2010 until December 2015 (as shown in Table I, Figure I and Figure II). The number of cases each year ranged from one to seven cases where there was a gradual increase from 2013 (n=1) to 2015 (n=7).

Breed represented in Feline group were Domestic Short Hair (14 cats), American Short Hair cross (two cats) and Siamese (one cat) while breed represented in Canine group were Shih-tzu (two dogs) and Spitz cross (one dog). The mean age in Feline group was 2.1years (range from 2 months to 5.5 years) while the mean age in Canine group was six years (range from four years to nine years). Patients aged less than one year old were categorized as young cats (40%) or young dogs (0%) while patients aged equal to or more than one year old were categorized as adult cats (45%) or adult dogs (15%). Among 17 cats, there were 14 intact male (82%), two castrated male (12%) and one intact female (6%) while there were all intact male (100%) among the three dogs.

There was significant association between feline and canine species on indication for urethrostomy (p= 0.048) but showed no significant association on age group (p=0.242), sex (p=1.000), neuter status (p=1.000), clinical presentations (p=0.696), complications after urethrostomy (p=0.147) and response to treatment (p=0.679). However, there was no significant association between two age group (young and adult) on sex (p=0.400), neuter status (0.302), types of urethrostomy (p=0.103), clinical presentations (p=0.080), complications after urethrostomy (p=0.282) and response to treatment (p=0.523).

Indications for urethrostomy in Feline group were urethral rupture (59%), urethral stenosis (29%), urolithiasis (6%) and urethral fistula (6%) while indications for urethrostomy in Canine group were urethral stenosis (33%) and urolithiasis (67%) (as shown in Figure III). There was no significant association between indications for urethrostomy on complication after urethrostomy ($p=0.735$) and response to treatment ($p=0.641$).

Most common clinical presentation shown in cats prior to urethrostomy was stranguria (41%), followed by urethral stenosis (35%), urinary incontinence (29%), urine dribbling from fistula (29%), hypothermia (29%), hematuria (18%), tachycardia (18%), unable to urinate (18%), pollakiuria (12%), leaking urine from insertion point of urinary catheter (6%), vomiting (6%), bradycardia (6%) and periuria (6%). In dogs, common clinical presentations shown prior to urethrostomy were urinary incontinence (100%), stranguria (67%) and hematuria (33%). (The data was shown in Table II.) (Be noted that one patient could show more than one type of clinical presentation.)

For types of urethrostomy performed in the cases (as shown in Figure IV), most cats had undergone prepubic urethrostomy (65%) and others had undergone perineal urethrostomy (35%). Prescrotal urethrostomy was performed in 67% of dogs (one of the surgery was reconstruction of prescrotal urethrostomy site due to complication occurred after prescrotal urethrostomy done by private veterinarian) and scrotal urethrostomy was performed in 33% of dogs. There was no significant association between the four types of urethrostomy on indications for urethrostomy ($p=0.736$), complications after urethrostomy ($p=0.136$) and response to surgery ($p=0.372$).

The follow-up period post-urethrostomy in this study was ranged from one day to two years after urethrostomy. Complications post-urethrostomy in cats included urine burn (29%), bruises (12%), seroma (12%), hemorrhage (6%), euthanized or died (12%) and granulomatous lesion at urethral opening(6%). Among the three dogs, all dogs showed hemorrhage (100%) after urethrostomy and one of them had bruises at surgical site (33%). The complications post-urethrostomy in cats and dogs were showed in Figure V. Overall response to urethrostomy in cats and dogs were categorized into four groups which were good, primary problem solved with complication, euthanized or died and unable to be assessed due to short follow-up period (less than seven days after urethrostomy) (as shown in Figure VI). Most cats and dogs showed good response to surgical treatment (47% of the cats and 100% of the dogs), while 29% of the cats had primary problem solved with occurrence complication, 12% of the cats were euthanized or died and 12% of the cats were unable to be assessed due to short follow-up period. The short follow-up period was due to owners insisted to bring back the patients after one day or three days after surgery and did not bring their cats back to hospital for routine reassessment.

5.0 Discussions

In this study, urethrostomy was relatively common in cats (85%) than dogs (15%) However, this study was reported on a relatively small number of cats and dogs as urethrostomy was not commonly indicated in UVH and its prevalence over total surgery being performed in UVH in each year was less than 1%. Besides, there were missing medical and surgical records as well as data for long-term outcome were lacking as some of the patients did not return for re-evaluation.

The objective of this study was to identify the indications for and outcome of urethrostomy in cats and dogs presented to UVH from 2010 to 2015 while this study revealed that urethral rupture was the most common indication for urethrostomy in cats (58.82%). There was also statistical difference between cats and dogs on their indications for urethrostomy. The higher incidence of urethral rupture in cats could be due to traumatic injury caused by car accident or iatrogenic trauma that induced by urethral catheterization during treatment of FLUTD (Newton *et al.*, 1996). Moreover, there was also reported risk factor that cause urethral rupture including fractured pelvis or femur (Chew *et al*, 2011). Furthermore, the study also showed that in cases of urethral rupture will further cause complication such as urine accumulation in the soft tissues of the perineum, caudal thighs, and inguinal region which further lead to bruising, cellulitis, and sloughing of tissues after 12 to 36 hours (Chew *et al*, 2011). However, in this study we found out that from the total number of 9 cats which diagnosed with urethral rupture, one of the cat suffered from left femoral fracture, one of the cat having bruise, another one cat diagnosed with uroperitoneum which is similar to the study above. On top of that, there are 3 cats diagnosed with urethral rupture had concurrent fistulation and another 3 cats suffered from urinary

incontinence. A useful diagnostic method in confirming urethral rupture is contrast urethrogram (Hecht, 2015). Figure IX showed the positive contrast urethrograph of a cat involved in this study that was diagnosed with urethral rupture. Study also showed that positive contrast urethrography was considered more superior to ultrasonography for the diagnosis of urethral rupture as it provided more information on location of rupture than ultrasound by showing extravasation of contrast medium into surrounding soft tissue and/or peritoneal cavity (Hecht, 2015).

In one study where 59 cats underwent PU, the most common pre-operative diagnosis was urethral uroliths (52.2%), followed by bacterial urinary tract infection (18.6%), idiopathic FLUTD (11.9%) and less frequently urinary bladder uroliths, urinary bladder rupture, perineal skin infection and urethral non-mineral plug. (Birchard *et al*, 2006). Another similar retrospective study revealed that the major indications for the procedure were stenosis of a previous PU or obstruction of the pelvic urethra secondary to ILUTD (Bass *et al.*, 2005). The variation in indications for urethrostomy in cats between this study and other studies could be due to small number of sample size involved that make these studies cannot generalize their results to others.

Furthermore, this study reported that the most common type of urethrostomy in cats in UVH was PPU (64.71%). This could be due to most of the patients that undergone PPU had involved in car accident and had diagnosis of urethral rupture with rupture site at more proximal of urethra (intrapelvic urethra). However, currently there was no study done on association between traumatic injury and urethral rupture site.

This study also showed that urolithiasis was the most common indication for urethrostomy in dogs (66.67%) but there was too few cases involved to comment on

the relative merits of the objective of this study. However, both cases showed good response post-operatively with combination of appropriate diet management by using suitable prescription diet. The normal diagnostic method for urolithiasis is usually via first taken a survey radiograph where they may appear as rounded to spiculated mineral opacities of variable size in the plane of the urinary bladder and/or urethra (Hecht, 2015). Figure X showed an abdominal radiograph of a dog that was diagnosed with urolithiasis. However, if the uroliths did not catch up in survey radiograph further diagnostic imaging technique using contrast urethrography can be carried out to improved detectability of less opaque and some radiolucent calculi such as silica, urate and cysteine calculi (Hecht, 2015). If the urolith is caught up in the contrast urethrography, it will show intraluminal filling defect in the contrast medium column (Thrall, 2007). In our study, one of the cases was diagnosed via plain radiograph alone while another case was diagnosed by using plain radiograph and proceeded with contrast urethrography which had similar result as mentioned above. Indications for penile amputation and scrotal urethrostomy in another study were neoplasia which included preputial neoplasia (mast cell tumour, liposarcoma, haemangiosarcoma) and penile/urethral neoplasia (squamous cell carcinoma), penile trauma, urethral obstruction with calculi, priapism and balanoposthitis. The long-term outcome was excellent in all dogs that had non-neoplastic disease (Burrow *et al.*, 2011).

From our study, we found out that 6 of the 17 cats did not suffer from any complication postoperatively for a followed up period of one day to 2.5 months. While among all the complications presented postoperatively in this study, most of the complications was urine burn which had shown in five of the cats as fast as on day 2 post surgery. From five of the cases mentioned above, four of the cases were PPU and

the remaining one case was PU. This study revealed that among all of the cases that had postoperatively urine burn, the patient that had undergone PU appeared to show sign of urine burn on day 2 post-surgery and resolved spontaneously after that. In contrast, the patients underwent PPU developed urine burn later postoperatively ranging from 3 weeks to 8 months. There was one study regarding long term management of prepubic urethrostomy cat postoperatively showed that most of their cats experienced some form of complications (69%) which included intermitant urine leakage and peristomal skin irritation (Baines *et al.*, 2001) which were similar to our study whereby the peristomal skin irritation probably due to chronic urine burn. However, from that study, it showed that all of the cats were alive at the end of followed up period (62 months) (Baines *et al.*, 2001). Hence, the postoperative management was very crucial for the urethrostomy patient especially PPU to ensure less complication and better life quality thereafter. Furthermore, prepubic urethrostomy were unpredictable with various complications such as urinary incontinence, subcutaneous leakage of urine, stricture of the urethrostomy, recurrent UTI and urine scald dermatitis (Langley, 2014). From our study, one of the patients died one day post-PPU due to unknown reason while the other cat was euthanized on second day post-PPU due to critical condition caused by history of road-vehicle accident. Hence from all the various complications and unpredictable outcome as mentioned above, it warranted the selection of PPU against PU.

Besides, from three of the dogs in our study, all of them showed complication such as mild hemorrhage while one of the dogs showed bruises. From all of the dogs which suffered from mild hemorrhage postoperatively, the period for the condition to resolve ranged from two days to eleven days. From one study, it indicated that the

most common complication after SU was hemorrhage from the surgical site (Newton *et al.*, 1996). Precaution had to be taken during SU in order to avoid ischiocavernosus muscles by staying on the midline incision to prevent excessive hemorrhage when accidentally incise them (Monnet, 2013). Smeak D.D introduced the use of modified technique in scrotal urethrostomy by using a continuous suture pattern and a three-needle bite sequence for urethrostomy closure which could reduce the chance of bleeding and bruising complication as compared to the standard methods (Smeak, 2000). This was shown in one study whereby dogs that underwent standard technique experienced hemorrhage for an average of 4.2 days postoperatively (Smeak, 2000). The rationale behind the modified technique by using simple continuous suture patterns was to produce a completely apposing tissue with a better seal as well as to reduce skin irritations as less knobs were required (Smeak, 2000). Other than that, the modified technique could also be conducted by incorporation of a bite of tunica albuginea which provided additional strength to the incision line and helped in sealing incised cavernous edges thus reduced suture line breakdown and hemorrhage complication (Smeak, 2000).

On the other hand, from this study we found out that most of our patients (55%) had good respond to surgery postoperatively while 25% of our patients that underwent surgery had their primary problem resolved but with complication thereafter. From various studies we could conclude that, long-term outcome of urethrostomy in both cats and dogs was good in majority of the patient with low recurrence rate (Ruda *et al.*, 2012; Burrow *et al.*, 2011; Bass *et al.*, 2005; Baines *et al.*, 2001). However, some studies also shown that in order to achieve a good postoperative surgical and clinical outcome, various factors may come into play such as surgeon with variable degree of

skills and experience, surgical technique, suture materials used, anaesthetic methods and postoperative care (Ruda *et al.*, 2012). Hence this explained for the discrepancies between the studies and the advancement in more mature technique over the years might partially explain the differences in success rate (Ruda *et al.*, 2012).

6.0 Conclusion

In conclusion, a total of 20 urethrostomy cases were performed in UVH over six years (2010-2015) which included 17 Feline cases and three Canine cases. There were four types of urethrostomy involved in this study which were perineal urethrostomy and prepubic urethrostomy in cats and scrotal urethrostomy and prescrotal urethrostomy in dogs. This study revealed that urethral rupture was the most common indication for urethrostomy in cats (58.82%) while urolithiasis was the most common indication for urethrostomy in dogs (66.67%). Most of the cases were diagnosed via contrast urethrography. There was statistical difference between two species on indications for urethrostomy. Among all of the complications presented postoperatively, most of the complications occurred in cats was urine burn (29%) while in dogs was mild hemorrhage (100%). However, most of the cats (55%) and all of the dogs had good response to surgery postoperatively.

7.0 Recommendation

As for my recommendation after conducting this study, I would like to suggest that better record keeping system and management should be practiced in UVH as some of the records/data regarding the sample had gone missing and unable to be retrieved. This can be achieved by implementing computerized database record keeping system and management so that patient records can be traced easily and effectively.

Besides, I would also like to suggest all the small animal clinicians to complete the radiological diagnosis or interpretation in the written recorded as this would help everyone who is reviewing the radiological history of the patients.

In conclusion, I would also like to recommend future retrospective study regarding the number of catheterization in cats with FLUTD in association with justification to perform urethrostomy. Furthermore, another future prospective study comparing the outcome of urethral stricture cases by treatment using urethrostomy versus synthetic stent can be done.

References

Baines S.J., Rennie S., White R.A.S. (2001). Prepubic Urethrostomy: A Long-Term Study in 16 Cats. *Veterinary Surgery* 30, 107-113.

Bass M, Howard J, Gerber B, *et al*. (2005). Retrospective study of indications for and outcome of perineal urethrostomy in cats. *Journal of Small Animal Practice* 46, 227-231.

Bernarde A., Viguier E. (2004). Transpelvic Urethrostomy in 11 Cats Using an Ischial Ostectomy. *Veterinary Surgery* 33, 246-252.

Bilbrey SA, Birchard SJ, Smeak DD. (1991). Scrotal urehtrostomy: a retrospective review of 38 dogs (1973 through 1988). *Journal of the American Animal Hospital Association* 27, 560-564.

Birchard, S. J., Sherding, R. G., & Hilary, M. K. (2006). *Saunders manual of small animal practice* (3rd ed.). St. Louis, Missouri: Elsevier. Chp. 81, 922-929.

Bjorling D. E. (2003). The urethra. *In Textbook of Small Animal Surgery. Vol II.* 3rd edn. Ed D. E. Slatter. Saunders, 1643.

Bovee, K., Reif, J., Maguire, T., Gaskell, C. & Batt, R. (1979). Recurrence of feline urethral obstruction. *Journal of the American Veterinary Medical Association* 174, 93.

Burrow R.D., Gregory S.P., Giejda A.A., White R.N. (2011). Penile amputation and scrotal urethrostomy in 18 dogs. *Veterinary Record* 2011 169, 657.

Carb A, Yoshioka MM (1982). Antepubic urethrostomy in the dog. *Journal of the American Animal Hospital Association* 18, 290-294.

Chew D.J., DiBartola S.P., Schenck P.A. (2011). Urinary Tract Trauma and Uroperitoneum. Canine and Feline Nephrology and Urology (2nd ed.). St. Louis, Missouri: Elsevier. Chp. 12, 391-408.

Corgozinho B. K., Souza H.JM., Pereira A., et al. (2007). Catheter-induced urethral trauma in cats with urethral obstruction. *Journal of Feline Medicine and Surgery (2007)* 9, 481-486.

Fossum, T. W. (2002). *Small animal surgery* (2nd ed.). St. Louis, MO: Mosby/Elsevier.

Gerber, B., Boretti, F. S., Kley, S., Laluha, P., Muller, C., Sieber, N., Unterer, S., Wenger, M., Fluckiger, M., Glaus, T. & Reusch, C. E. (2005). Evaluation of clinical signs and causes of lower urinary tract disease in European cats. *Journal of Small Animal Practice* 46, 571-577.

Griffin DW., Gregory CR. (1992). Prevalence of bacterial urinary tract infection after perineal urethrostomy in cats. *Journal of the American Veterinary Medical Association* 200,681-684.

Harari, J. (2004). *Small animal surgery secrets* (2nd ed.). Washington: Elsevier, 212.

Hecht S. (2015). Diagnostic Imaging of Lower Urinary Tract Disease. *Vet Clin Small Anim* 45, 639-663.

Kyles A. E., Aronsohn M., Stone E. A. (1996). Urogenital surgery. *In Complications in Small Animal Surgery*. Eds A.J. Lipowitz, D.D. Caywood, C.D. Newton, A. Schwartz, C.C. Cann. Lippincott Williams and Wilkins, 455-526.

Langley-Hobbs, S. J. (2014). *Feline soft tissue and general surgery*. Edinburgh ˜œ: Saunders, Elsevier.

Little S.E. (2012). Urinary Tract Disorder. The Cat: Clinical Medicine and Management. St. Louis, MO: Elsevier Saunders.

Mary A. M. (2011). Complications of Lower Urinary Tract Surgery in Small Animals. *Vet Clin Small Anim* 41, 889-913.

Monnet, E. (2013). *Small animal soft tissue surgery* (1st ed.). Ames, IA: John Wiley & Sons.

Newton JD, Smeak DD. (1996). Simple continuous closure of canine scrotal urethrostomy: result in 20 cases. *Journal of the American Animal Hospital Association* 32, 531-534.

Osborne C.A., Caywood D.D., Johnston G.R. *et al*., (1996). Feline Perineal Urethrostomy. A Potential Cause of Feline Lower Urinary Tract Disease. *Veterinary Clinics Of North America: Small Animal Practice* 26(3), 535-549.

Ruda L. , Heiene R. (2012). Short- and long-term outcome after perineal urehtrostomy in 86 cats with feline lower urinary tract disease. *Journal of Small Animal Practice* 53, 693-698.

Smeak D.D. (2000). Urethrotomy and Urethrostomy in the Dog. *Clinical Technique in Small Animal Practice* 15(1), 25-34.

Smith C.W, Schiller AG. (1978). Perineal urethrostomy in the cats: a retrospective study of complications. *Journal of the American Animal Hospital Association* 14, 225-228.

Smith C.W. (2002). Perineal Urethrostomy. *The veterinary Clinics Small Animal Practice* 32, 917-925.

Smith CW. (1993). Surgical diseases of the urethra, *in: Slatter D (ed): Textbook of Small Animal Surgery*. Philadelphia, PA,Saunders, 1462-1473.

Stone EA., Barsanti JA. (1992). Urologic Surgery of the Dog and Cat. *Lea & Febiger*, 135-196.

Thrall, D. E. (2007). *Textbook of veterinary diagnostic radiology* (6th ed.). St. Louis, MO: Saunders Elsevier.

Westropp, J. L., Buffington, T. C. A. (2010). Lower urinary tract disorders in cats. *In: Textbook of Veterinary Internal Medicine*. 7th edn. Eds S. J. Ettinger. Saunders Elsevier, St Louis, MO, USA, 2069-2086.

Wilson GP., Harrison JW. (1971). Perineal urethrostomy in cats. *JAVMA* 159, 1789–93.

Yool, D.A. (2012). Urinary Tract Surgery. *Small Animal Soft Tissue Surgery.* Wallingford, Oxfordshire:CAB International.

Appendix

Table I: Number of cases and prevalence of urethrostomy being performed in UVH, UPM from 2010 to 2015 (n=20).

Year	Number of cases	Total cases of surgery being performed in UVH	Prevalence (%)
2010	1	442	0.23
2011	4	571	0.70
2012	3	685	0.44
2013	1	694	0.14
2014	4	835	0.48
2015	7	924	0.76
Total	20	4151	0.48

Table II: Tabulated result

	Number of Cases	
	Feline (N=17)	**Canine (N=3)**
Clinical Presentation		
Stranguria	7	2
Urine Incontinence	5	3
Urethral stenosis	6	0
Urine Dribbling from Fistula	5	0
Hypothermia	5	0
Hematuria	3	1
Tachycardia	3	0
Unable to Urinate	3	0
Pollakiuria	2	0
Leaking Urine from Catheter	1	0
Vomiting	1	0
Bradycardia	1	0
Periuria	1	0
Indication		
Urethral rupture	10	0
Urethral stenosis	5	1
Urolithiasis	1	2
Urethral fistula	1	0
Types of Urethrostomy		

Perineal Urethrostomy	6	0
Prepubic Urethrostomy	11	0
Prescrotal Urethrostomy	0	2
Scrotal Urethrostomy	0	1
Complication		
No complication	6	1
Urine burn	5	0
Haemorrhage	1	3
Bruises	2	1
Seroma	2	0
Granulomatous lesion at urethral opening	1	0
Euthanized/ Died	2	0
Response to Urethrostomy		
Good	8	3
Primary Problem Solved with Complication	5	0
Euthanized/ Died	2	0
Unable to be Assessed due to Short Follow-up Period (<7days)	2	0

Figure I: Number of cases of urethrostomy being performed in UVH, UPM from 2010 to 2015 (n=20).

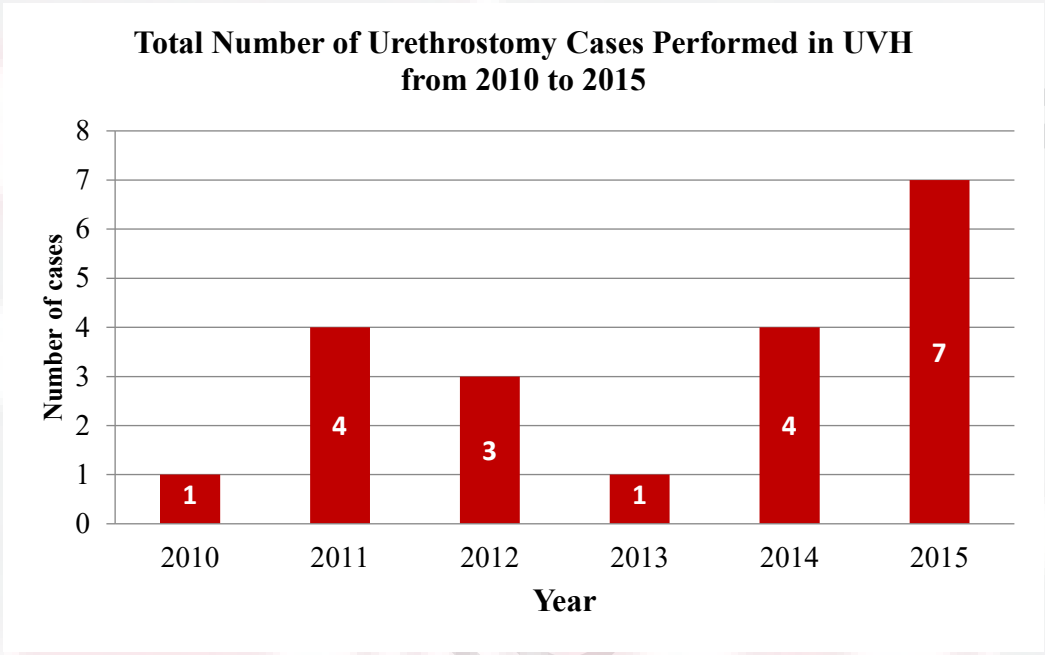

Figure II: Number of cases of urethrostomy corresponds to species in UVH, UPM from 2010 to 2015 (n=20).

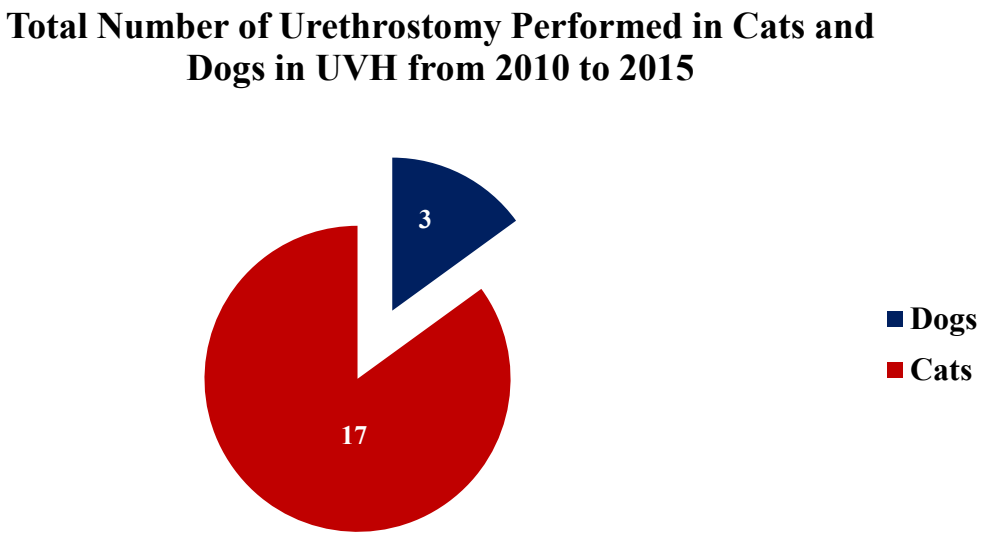

Figure III: Indications for Urethrostomy corresponds to species in UVH, UPM from 2010 to 2015 (n=20).

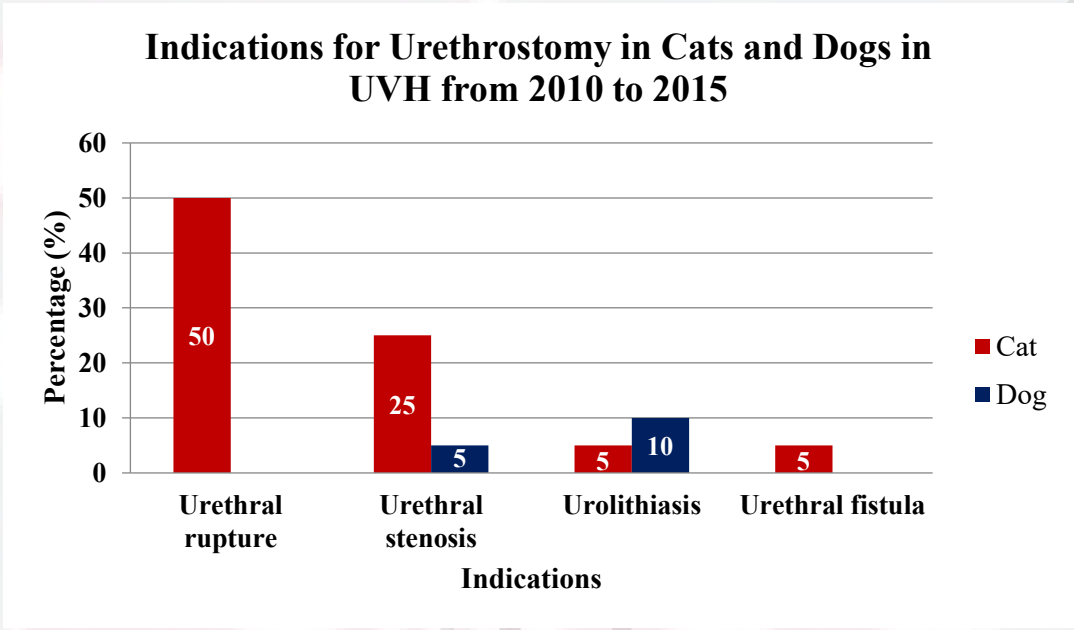

Figure IV: Types of urethrostomy being performed in UVH, UPM from 2010 to 2015 (n=20).

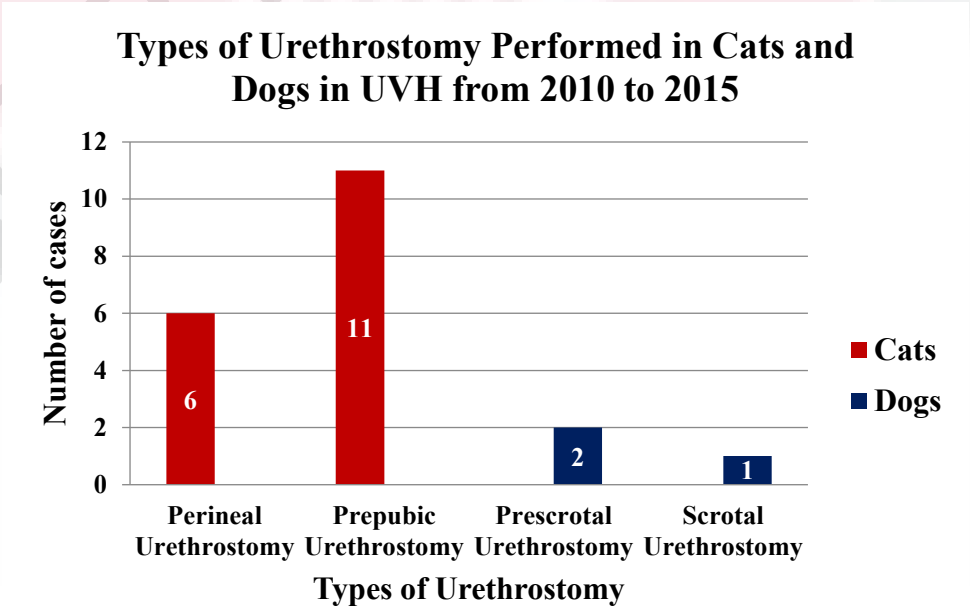

Figure V: Complications of Urethrostomy corresponds to species in UVH, UPM from 2010 to 2015.

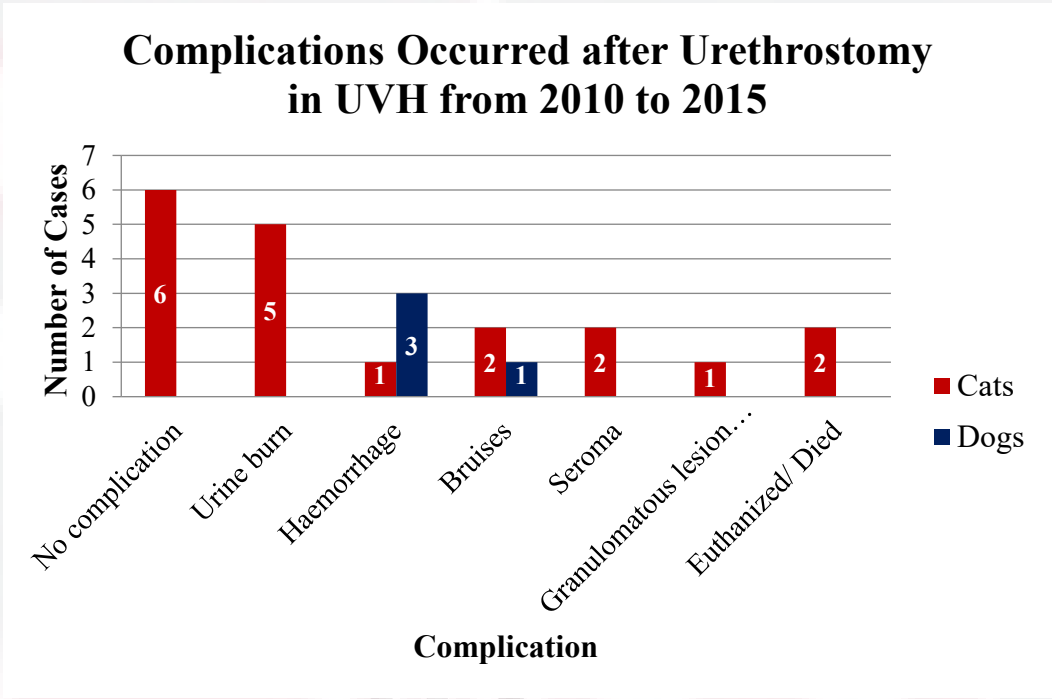

Figure VI: Response to treatment corresponds to species in UVH, UPM from 2010 to 2015 (n=20).

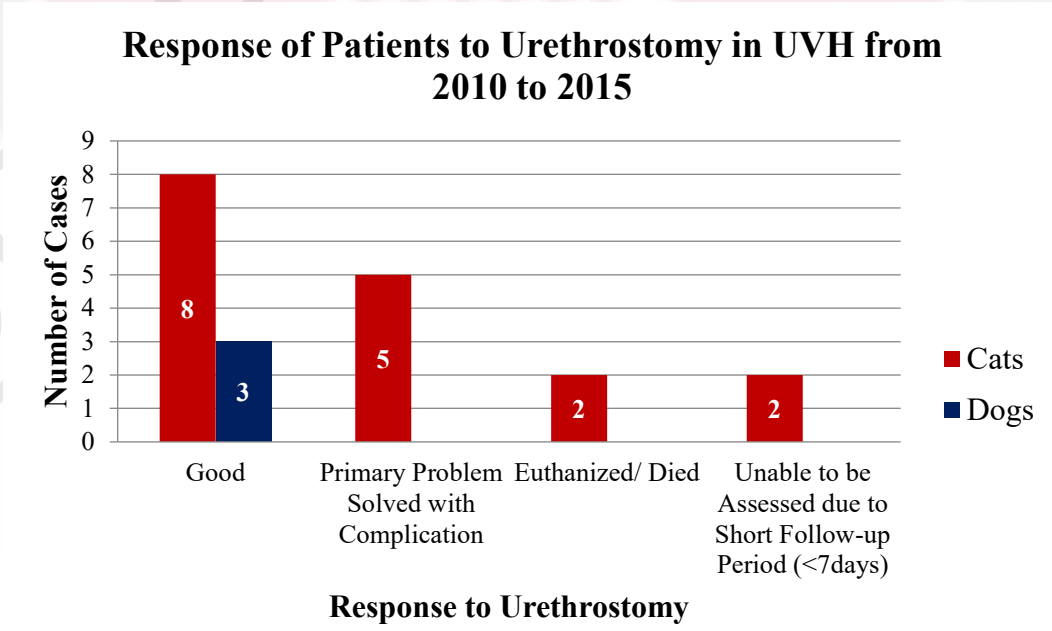

Figure VII: Diagram of the male feline urethra (Illustrated from Langley-Hobbs, S. J.: Urethra. *In Feline soft tissue and general surgery*. Edinburgh ˜œ: Saunders, Elsevier, 2014, p434)

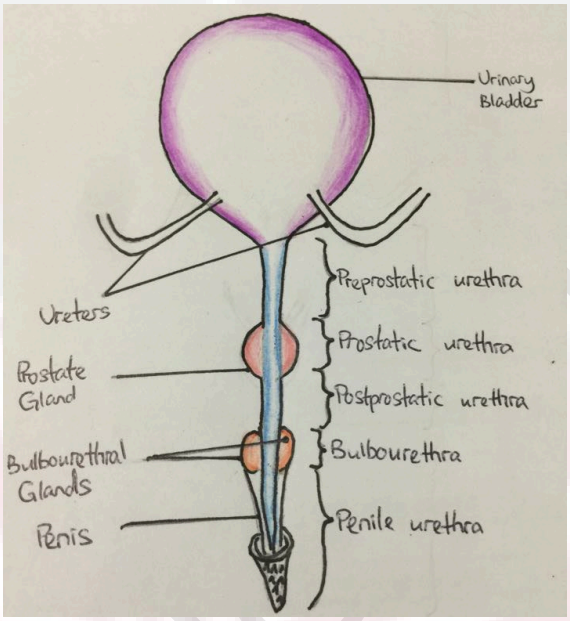

Figure VIII: Diagram of the male canine urethra (Illustrated from Fossum, T.W.: Surgery of the Bladder and Urethra. *In Small animal surgery* (2nd ed.). St. Louis, MO: Mosby/Elsevier., 2002, p575)

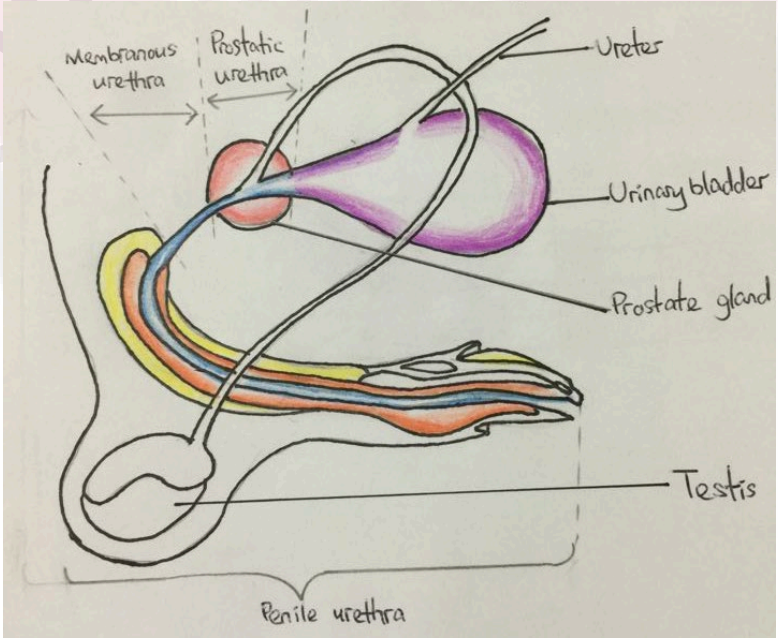

Figure IX: Positive Contrast Urethrograph of a cat that diagnosed with urethral rupture.

Figure X: Abdominal radiograph of a dog that diagnosed with urolithiasis.

Figure XI: Post-Prepubic Urethrostomy site of a cat