การแก้ไขไส้เลื่อนข้างทวารหนักโดยใช้เยื่อหุ้มอัณฑะปลูกถ่ายของตัวเองในสุนัข

นางสาวกิตติยา ประทุมมินทร์

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
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# PERINEAL HERNIA REPAIR USING A TUNICA VAGINALIS AUTOGRAFT IN DOGS

Miss Kittiya Pratummintra

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

A Thesis Submitted in Partial Fulfillment of the Requirements
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Department of Veterinary Surgery
Faculty of Veterinary science
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กิตติยา ประทุมมินทร์ : การแก้ไขไส้เลื่อนข้างทวารหนักโดยใช้เยื่อหุ้มอัณฑะปลูกถ่ายของตัวเองในสุนัข. (PERINEAL HERNIA REPAIR USING A TUNICA VAGINALIS AUTOGRAFT IN DOGS) อ. ที่ปรึกษาวิทยานิพนธ์หลัก : ศาสตราจารย์นายสัตวแพทย์ ดร. มาริษศักร์ กัลล์ประวิทธ์, 58 หน้า.

การแก้ไขไส้เลื่อนข้างทวารหนักโดยใช้เยื่อหุ้มอัณฑะปลูกถ่ายของตัวเอง ในสุนัขป่วย เพศผู้และยังไม่ได้ทำหมัน ที่เข้ามารับการรักษาที่โรงพยาบาลสัตว์เล็ก คณะสัตวแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย จำนวน 19 ตัว เป็นไส้เลื่อนข้างเดียวจำนวน 14 ตัว และ เป็นไส้เลื่อนทั้งสองข้างจำนวน 5 ตัว มีไส้เลื่อนทั้งหมด 22 ข้างที่ได้รับเยื่อหุ้มอัณฑะปลูกถ่าย สุนัขป่วยได้รับการทำศัลยกรรมตัดลูกอัณฑะ และเตรียมแผ่นเยื่อหุ้มอัณฑะก่อนทำการศัลยกรรมแก้ไขไส้เลื่อน การทำศัลยกรรมแก้ไขไส้เลื่อนจำนวน 17 ข้างที่มีช่องเปิดไม่ได้ขยายลงทางด้านล่างของรูทวาร ใช้การปลูกถ่ายเยื่อหุ้มอัณฑะเพียงอย่างเดียว ส่วนไส้เลื่อนจำนวน 5 ข้างที่มีช่องเปิดขยายกว้างลงไปทางด้านล่างของรูทวาร หรือขนาดของช่องเปิดไส้เลื่อนมีขนาดใหญ่มาก การแก้ไขใช้การปลูกถ่ายเยื่อหุ้มอัณฑะร่วมกับการย้ายตำแหน่งกล้ามเนื้อ internal obturator จากการติดตามผลเป็นระยะเวลาเฉลี่ย 8.51 (±3.61) เดือน พบว่ามีอัตราความสำเร็จคิดเป็นร้อยละ 88.23 (15 ข้าง) ของไส้เลื่อนที่ได้รับการปลูกถ่ายเยื่อหุ้มอัณฑะเพียงอย่างเดียว และร้อยละ 100 (5 ข้าง) ของไส้เลื่อนที่ได้รับการปลูกถ่ายเยื่อหุ้มอัณฑะร่วมกับการย้ายตำแหน่งกล้ามเนื้อ internal obturator หลังการผ่าตัดเป็นเวลา 3 เดือน สุนัขจำนวน 18 ตัว สามารถขับถ่ายได้ปกติ ส่วนสุนัขอีก 1 ตัว มีอาการเบ่งถ่ายเล็กน้อย พบการกลับมาเป็นใหม่ของไส้เลื่อนจำนวน 2 ตัวและได้รับการศัลยกรรมแก้ไขและการตัดตัวอย่างชิ้นเนื้อของเยื่อหุ้มอัณฑะที่ได้ทำการปลูกถ่ายไว้และเนื้อเยื่อใกล้เคียงเพื่อตรวจทางจุลพยาธิวิทยา พบว่าเนื้อเยื่อปลูกถ่ายยังคงมีชีวิตและไม่พบลักษณะการปฏิเสธเนื้อเยื่อปลูกถ่าย พบอาการแทรกซ้อนหลังการผ่าตัด ได้แก่ แผลผ่าตัดติดเชื้อ 3 ตัว แผลแตก 2 ตัว และ อัมพฤกษ์ชั่วคราวจากการกระทบเส้นประสาท sciatic 2 ตัว จากการศึกษาในครั้งนี้ พบว่าการปลูกถ่ายเยื่อหุ้มอัณฑะของตัวเอง เป็นวิธีการทำศัลยกรรมที่เหมาะสำหรับใช้แก้ไขไส้เลื่อนข้างทวารหนักในสุนัข ที่มีขนาดช่องเปิดไส้เลื่อนขนาดใหญ่หรือมีกลุ่มกล้ามเนื้อ pelvic diaphragm บาง ซึ่งไม่สามารถแก้ไขด้วยวิธีมาตรฐาน หรือ วิธีย้ายตำแหน่งกล้ามเนื้อ internal obturator และ เมื่อใช้วิธีการปลูกถ่ายเยื่อหุ้มอัณฑะนี้ ร่วมกับการย้ายตำแหน่งกล้ามเนื้อ internal obturator ให้ผลในการแก้ไขไส้เลื่อนข้างทวารหนักที่ดีกว่าการแก้ไขด้วยวิธีใดวิธีหนึ่งเพียงอย่างเดียว

ภาควิชา.....ศัลยศาสตร์..... ลายมือชื่อนิสิต.....

สาขาวิชา....ศัลยศาสตร์ทางสัตวแพทย์...ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก.....

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## 527 55537 31 : MAJOR VETERINARY SURGERY

KEYWORDS : DOGS / GRAFT / HERNIORRHAPHY / PERINEAL HERNIA / TUNICA VAGINALIS

KITTIYA PRATUMMINTRA : PERINEAL HERNIA REPAIR USING A TUNICA VAGINALIS AUTOGRAFT IN DOGS. THESIS ADVISOR : PROFESSOR MARISSAK KALPRAVIDH, B. Sc., D.V.M., M.S., Ph.D., 58 pp.

Perineal herniorrhaphy using an autologous tunica vaginalis was performed in 19 intact male dogs presented at the Small Animal Hospital, Faculty of Veterinary Science, Chulalongkorm University. Fourteen dogs had unilateral perineal hernia (PH) and 5 dogs had bilateral PH. There were 22 hernias receiving tunica vaginalis autografting. Before PH repair, all dogs were castrated and the tunica vaginalis was harvested. The tunica vaginalis autografting alone was used for repairing 17 hernias that the hernial ring did not extend to ventral of the anus. For 5 hernias with a very large hernial ring or that extended to ventral of the anus, combination of the autografting and transposition of the internal obturator muscle (TIOM) was performed. The postoperative follow-up of 8.51 (±3.61) months found the success rates of 88.23% (15 hernias) of the hernias receiving the autografting alone and 100% (5 hernias) of those receiving the autografting combined with TIOM. At 3 months after surgery, 18 dogs had normal defecation while 1 dog had mild defecation difficulty. Rehernias occurred in 2 dogs and were repaired by resuturing. The grafts together with the adjacent tissues were biopsied for histopathological examination. The grafts were viable and no sign of graft rejection was observed. Postoperative complications were wound infection (3 dogs), wound dehiscence (2 dogs), and temporary sciatic nerve paresis (2 dogs). In conclusion, tunica vaginalis autografting is suitable for repairing the hernia with large hernial ring or thin pelvic diaphragm muscles that is not a candidate of the standard herniorrhaphy or transposition of the internal obturator muscle. Use of this technique in combination with transposition of the internal obturator muscle provides a better result of perineal herniorrhaphy.

Department : Veterinary Surgery Student's Signature Kittiya Pratummintra

Field of Study : Veterinary Surgery Advisor's Signature Marissak Kalpravidh

Academic Year : 2010

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# Chapter I

# Introduction

## Importance and Rationale

Perineal hernia (PH) is a protrusion of the abdominal organs into the perineal area. It results from failure of pelvic diaphragm muscles that support the rectal wall. The pelvic diaphragm muscles consist of the coccygeal and levator ani muscles which are covered by the external and internal fascias. PH commonly develops between the external anal sphincter and levator ani muscle and occasionally develops between the levator ani and coccygeal muscles (Bellenger and Canfield, 2002). Deterioration of these muscles results in weakness of the rectal support. Causes of the deterioration could be one or combination of the pathological processes including sex hormonal imbalance, prostate abnormalities, muscle atrophy, and myopathies (Bellenger and Canfield, 2002). The incidence of PH in dogs of 35.83% at Murdoch University Veterinary Hospital (1978-1999) and 44.03% at University of Sydney Veterinary Teaching Hospital (1974-1989) have been reported (Read and Bellenger, 2002). PH is most common in aging male dogs (7-9 years) and rarely found in female or age before 5 years (Bellenger and Canfield, 2002).

Clinical signs associated with PH would not be permanently eliminated by conservative treatment using medicine and dietary control. Surgical treatment is the treatment of choice for the reconstruction of the pelvic diaphragm and alleviation of the clinical signs (Bellenger and Canfield, 2002). Since the first report of suturing repair of the pelvic diaphragm in 1950s, there have been several reports on the use of standard perineal herniorrhaphy (Bojrab, 1981; Robertson,1984; Orsher, 1986; Anderson et al., 1998). Recurrence of PH commonly occurs at the ventral area (Vnuk et al., 2008) and is found at the rates of 10% (Petit, 1962), 15.4% (Bellenger, 1980), and 46% (Burrows and Harvey, 1973). Several techniques of perineal herniorrhaphy have been reported in attempt to lessen the recurrence. Among these, transposition of the internal obturator muscle (TIOM) is one of techniques that can increase the strength of the

ventral hernial area and decrease the recurrence rate to lower than 10% (Bellenger and Canfield, 2002). Other techniques that use the patient own tissue in closing the defect are transposition of the superficial gluteal muscle (Spreull and Frankland, 1980), transposition of the semitendinosus muscle (Chamber and Rawling, 1991). The success rate of the latter 2 techniques using the gluteal muscle were less than that of the standard herniorrhaphy. Use of fascia lata as an autologous graft for repairing PH was studied and no recurrence was found during 5.8 postoperative months. The dog lamed but was normal within a few days after surgery (Bongartz et al., 2005). Recent case report in a dog with PH repaired by closing the perineal hernial ring with an autologous tunica vaginalis flap inserted intraabdominally through the inguinal ring (Shigeo et al., 2004). An excellent result with no recurrence was found during 5 years of observation. Placement of prosthetic implants, either synthetic materials or biological grafts, is an alternative technique of PH repair in dogs. These materials include polypropylene mesh (Clarke,1989), porcine dermal collagen sheet (Frankland, 1986), and porcine small intestinal submucosa (PSIS) (Stoll et al., 2002). The success rate of polypropylene mesh placement is 91.7% (Clarke, 1989). A recent study has proved that PSIS is a suitable biomaterial for perineal herniorrhaphy in the dog (Stoll et al., 2002). Although uses of the synthetic and biological materials are effective, they are expensive. An ideal material should be inexpensive and easy to use, promote host tissue ingrowth, heal the defect with the strength equal to the normal tissue, resist the infection, not enhance the inflammatory response, and inhibit adhesion and fistula formation (Stoll et al., 2002).

There have been a few studies on the effective use of tunica vaginalis for repairing various defects such as the urethral defect in rabbits (Calado et al., 2005; Leslie et al., 2009), the abdominal wall defects in rats (Hafeez et al., 2005), the umbilical hernia in sheep (Abass, 2008), and the induced urinary bladder wall defect in dogs (Wongsetthachai et al., 2010). The purpose of this study was to repair large PH with an autologous tunica vaginalis graft in dogs. The graft could be harvested right before perineal herniorrhaphy from castration which should be performed to eliminate the effect of relaxin on PH pathogenesis (Niebauer et al., 2005).

**Objectives of Study**

To evaluate the efficacy of the autologous tunica vaginalis graft in PH repair in dogs

**Research Frame**

This study was designed to use the tunica vaginalis as an autograft to repair PH in 20 dogs which were presented at the surgery unit of Small Animal Hospital, Faculty of Veterinary Science, Chulalongkorn University. Signalment, clinical signs, duration and side of PH, and concurrent diseases of the animals were recorded. All dogs were anesthesized and plain or contrast radiographs of the caudal abdomen and perineal area were taken before surgery to identify the herniated organs and concurrent rectal diseases. Afterwards, the dogs were castrated and the tunica vaginalis was harvested. Then, herniorrhaphy was performed using an autologous tunica vaginalis graft to strengthen the pelvic diaphragm. In case of hernial ring extended to ventral of the anus, transposition of the internal obturator muscle was additionally performed. In dogs with a very large PH, massive bowel herniation, recurrence, or rectal prolapse, the colopexy was also applied. During 4 postoperative days, the surgical wound was cleaned and observed for swelling, seroma, dehiscence, hematoma, and infection. Stitch removal was made 10 days after surgery after which the follow-up was made by phone call every 2 to 4 weeks. Defecation was subjectively assessed as normal or tenesmus by the dog owners. Radiographs and contrast radiography were indicated if rectal disorder or defecation difficulty remained.

**Research Question.**

Can tunica vaginalis be used as an autologous graft for PH repair in dogs?

**Keywords (Thai):**

สุนัข เนื้อเยื่อปลูกถ่าย การแก้ไขไส้เลื่อน ไส้เลื่อนข้างทวารหนัก เยื่อหุ้มอัณฑะทูนิกา วาจัยนาลิส

**Keywords (English):**

Dogs, Graft, Herniorrhaphy, Perineal hernia, Tunica vaginalis

**Advantages of Study**

Tunica vaginalis transplantation would be an alternative surgical treatment in the dog with moderate to large PH. The technique would be beneficial for the patient with very weak pelvic diaphragm which cannot be repaired solely by standard herniorrhaphy and/or transposition of the internal obturator muscle.



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# Chapter II

# Literature Review

Perineal hernia (PH) is caused by weakness of pelvic diaphragm resulting in protrusion of the internal organs. PH commonly occurs in old intact male dogs. Pathogenesis of PH involves many factors which may be one or combination of various pathological processes. The pathology includes muscular atrophy, myopathies, imbalance of gonadal hormone, and prostate involvement (Bellenger and Canfield, 2002). Castration can reduce relaxin hormone which increases in diseased prostate and causes friable pelvic diaphragm (Burrows and Harvey, 1973). Consequently, castration can reduce recurrent rate (Bellenger and Canfield, 2002). The commonly used surgical treatments of PH consists of standard herniorrhphy and transposition of the internal obturator muscle. The limitations of these surgical procedures are weak or friable pelvic diaphragm muscles including the internal obturator muscle (Aliabadi and Dehghani, 2007) and very large PH. Therefore, synthetic or biological material is used for repairing PH that is not the candidate of the standard herniorrhphy and transposition of the internal obturator muscle. However, both types of the materials are expensive and thus their use is limited. This study is interested in using the tunica vaginalis as an autograft for large PH repair in dogs. The graft can be harvested from castration right before herniorrhaphy. There was only one report on the use of a tunica vaginalis pedicle graft to repair PH with satisfied result of no recurrence or postoperative complications during 5 years of observation (Shigeo et al., 2004).

## Perineal anatomy

The perineum is part of the body wall which covers up the pelvic outlet and surrounds the rectum and urogenital canal. Boundaries of this area are the first caudal vertebra dorsally, the sacrotuberous ligament laterally, and the ischial tuberosities and arch ventrally. The important structure in this area is the pelvic diaphragm which composes of the levator ani and coccygeal muscles. The straplike coccygeal muscle extends from the ischiatic spine to transverse processes of the caudal vertebrae 2 to 4. The fan-shape levator ani muscle has two parts, the iliocaudal and pubocaudal parts.

The iliocaudal part extends from medial surface of the ilial body to ventral aspect of the caudal vertebra 5 while the pubocaudal part extends from dorsal surface of the pubis to ventral surface of the caudal vertebra 4. Actions of the coccygeal muscle and the iliocaudal part of the levator ani muscle are bilateral pressing the tail base against the anus and unilateral flexing the tail laterally. Action of the pubocaudal part of the levator ani muscle is bilateral compression on the rectal wall during defecation. Muscles forming a partition between the pelvic canal and the ischiorectal fossa consist of the external anal sphincter, the coccygeal and levator ani muscles medially, caudal part of the superficial gluteal muscle laterally, and the internal obturator muscle ventrally. Others important structures in this area include the pudendal nerve, internal pudendal artery and vein which should be identified and reflected during surgery (Bellenger and Canfield, 2002). Their direction is caudomedially over the internal obturator muscle towards root of the penis. The most important branch of the pudendal nerve innervates the external anal sphincture to control anal canal closure.

**Pathogenesis**

Etiology and pathogenesis of PH involve many factors causing deterioration of the pelvic diaphragm muscles which may be one or combination of various pathological processes. Muscular atrophy is the progressive process that may be neurogenic or senile (McGavin and Valentine, 2001). The neurogenic atrophy is resulted from partial or complete interruption of the nerve. The affected muscle is reduced in size but retains normally structural features. The interruption of the nerve may be resulted from straining during defecation that stretches the motor nerve (Harvey, 1977). Clinical signs are tenesmus and perineal swelling (Campbell and Lawson, 1963; Weaver, 1974). The senile atrophy develops gradually and all muscles of the body are affected to varying degree (McGavin and Valentine, 2001). Myopathies are primary degenerative conditions including muscular dystrophy, dermatomyositis, and polymyositis (Sjollema et al., 1993). Other disorders that may be associated with myopathies are endocrine imbalance and neoplasia.

Imbalance of gonadal hormones may involve in the pathogenesis of PH. Excessive estrogen from aging testis may contribute to relaxation of the pelvic diaphragm muscles (Petit, 1962). However, one study did not find estrogen receptors in the levator ani and coccygeal muscles in healthy beagle dogs before or after castration and in dogs with PH (Mann et al., 1995). Another theory implies that a deficiency of androgenic steroids can cause weakening of the pelvic diaphragm muscles (Mann et al., 1989). Concentrations of androgen receptors in the levator ani and coccygeal muscles in the castrated and noncastrated dogs with PH were lower than in the castrated and noncastrated dogs without PH. Moreover, significant increase of androgen receptors was observed after castration in normal dogs but not observed in the castrated dogs with PH. Paucity of androgen receptors may result in inadequate androgenic trophic influence and subsequent muscular atrophy leading to PH (Mann et al., 1995).

In a preliminary study of the effect of testosterone on the levator ani muscle in six male dogs, no correlation was found among the testosterone level, muscle fiber size, and fiber type I and type II distribution (Desai, 1982). Serum testosterone level in noncastrated dogs with PH was not significantly different from that in the noncastrated dogs without PH of the same age, whereas the serum testosterone level in the castrated dogs with PH was significantly less than that in the noncastrated dogs with PH and in the noncastrated dogs without PH (Mann et al., 1989). The serum testosterone-to-estradiol ratio paralleled the serum testosterone concentration. Because of no significant difference in serum estradiol-17ß concentration among the noncastrated dogs with PH, castrated dogs with PH, and noncastrated dogs without PH, castration is not recommended unless the prostatomegaly or other castration-responsive contributory factor is present (Mann et al., 1989).

Merchav et al. (2005) found higher relaxin receptor, compared with clinically normal dogs, within muscles of the pelvic diaphragm of dogs with PH. Relaxin hormone of the many species is synthesized in the prostate gland and secreted into the seminal plasma (Weiss, 1989). Relaxin may leak from the hypertrophied prostate of dogs causing local muscle atrophy and softening of the connective tissue, leading to PH

formation (Niebauer et al., 2005). Therefore, castration should be performed in dogs with PH to decrease relaxin production from the hypertrophic prostates and periprostatic tissue, commonly found in dogs with PH, to prevent the recurrence.

### Clinical signs

Clinical signs of PH are usually present as swelling on one or both sides of the perineal area, constipation (difficult defecation), obstipation (intractable constipation), tenesmus (straining to defecation), and dyschezia (painful defecation) which may be caused by concurrent rectal diseases. Stranguria (painful urination) may be associated with prostatic diseases or retroflexed urinary bladder. The bladder retroflexia occurs in 20-25% of the dogs with PH (Hosgood et al., 1995). Other occasional clinical signs include ulceration of the skin overlying the swelling, fecal incontinence (Burrows and Harvey, 1973; Sjollema and Sluijs, 1989), urinary incontinence (Sjollema and Sluijs, 1989), and altered tail carriage (Bellenger, 1980).

### Diagnostic tools

Diagnosis of PH is based on history, clinical signs, physical examination including rectal examination, radiology, and ultrasonography. During the early stage of perineal hernia, diagnosis may be difficult, however, it is obvious when clinical signs are progressive (Anderson et al., 1998). The distinct clinical sign indicating PH is swelling of one or both sides of the perineal area (Bellenger and Canfield, 2002).

Rectal examination can assess the support deficit of the pelvic diaphragm on one or both sides of the rectum. Rectal deviation (curvature of the rectum into the hernia), rectal sacculation (unilateral dilation of the rectal wall), rectal dilation (bilateral dilation of the rectal wall), and rectal diverticulum (tearing of seromuscular layers of the rectal wall resulting in mucosa protrusion into the hernia) may be found (Vnuk et al., 2008).

For patients with clinical signs of urinary tract involvement, the caudal abdominal radiographs should be taken. Furthermore, radiographs can identify others herniated organs. If the urinary bladder is not clearly seen in plain radiographs, retrograde urethrography or cystography should be additionally performed (Anderson

et al., 1998). Ultrasonography is a beneficial noninvasive diagnostic tool that can identify location of the urinary bladder and diseased prostate. In addition, ultrasonography can be used for guiding cystocentesis and prostatocentesis (Anderson et al., 1998).

**Medical and dietary treatments**

Medical treatment is adjunctive to the surgical treatment. Without surgical procedure, the clinical signs associated with PH would not be permanently cured (Harvey, 1977). Goal of the medical treatment is to palliate the clinical signs by softening feces and maintaining regular defecation.

The medical treatment consists of giving high fiber and moist food, bulk-forming laxatives (to retain water and electrolytes on the intestinal lumen to soften and increase fecal bulk) (Upson, 1972; Fingl, 1980), docusates (to reduce absorption of electrolytes, to increase permeability of the mucosa, and to keep feces soft) (Fingl, 1980), and hormonal therapy (such as castration in case of prostate gland hyperplasia) (Bellenger and Canfield, 2002).

**Surgical treatments**

Two surgical techniques commonly used are standard herniorrhaphy and transposition of the internal obturator muscle (TIOM). The standard herniorrhaphy is the anatomical reposition technique which places simple interrupted sutures securing together the external anal sphincter, levator ani and coccygeus muscles, and sacrotuberous ligament at the ventrolateral perineal area. In addition, suturing the external anal sphincture with the internal obturator muscle is commonly performed (Hedlund and Fossum, 2007). The advantage of this technique is that the procedure is not complicated but it is difficult to close the ventral aspect of the hernia. Postoperative tenesmus and rectal prolapse are frequently found (Hedlund and Fossum, 2007) and the recurrence rate after this technique ranges from 10 to 46% (Petit, 1962; Burrows and Harvey, 1973).

TIOM is performed by elevating and rolling up the periosteum together with the internal obturator muscle from the ischium over the defect to allow incorporation of the muscle with the external anal sphincter, coccygeal, and levator ani muscles (Hedlund and Fossum, 2007). Strength of the pelvic diaphragm was improved after the TIOM. A comparative study on the correction of PH by TIOM and standard herniorrhaphy found the recurrence rates of 11% and 27%, respectively (Vnuk et al., 2008). Furthermore, less tension on the suture line and less deformity of the anus were observed after TIOM. However, this technique is limited in case of weak and friable internal obturator muscle (Aliabadi and Dehghani, 2007).

**Others surgical procedures**

Superficial gluteal muscle transplantation (Spreull and Frankland, 1980) and use of the semitendinosus muscle flap (Chamber and Rawling, 1991) in attempt to make a strong pelvic diaphragm have been reported.

**Superficial gluteal muscle transplantation**

Transplantation of the superficial gluteal muscle has been reported in some cases of large breed dogs especially the Boxer in which TIOM is not feasible because of inadequate length of the muscle to cover the defect. This technique is also used when the coccygeal muscle is deficient (Bellenger and Canfield, 2002). The surgical procedure is performed with the dog in lateral recumbency and the affected side upward. An incision is made extending from thigh to the anal sphincter. Skin and fascia are reflected to expose the superficial gluteal muscle on the craniodorsal aspect of the biceps muscle. Tendon of the biceps at its insertion, the trochanter tertius at the proximal fifth of the lateral aspect of the femur, and the posterior part of tensor fascia lata are cut and reflected to cover the ischiorectal fossa. The anterior gluteal blood and nerve supply are preserved to make the transplanted muscle flap alive. The gluteal aponeurotic tendon is placed over and sutured with the external anal sphincter muscle while the muscle belly is sutured to the adjacent tissues below and above the fossa. Then, the subcutaneous tissue and skin are closed. In one study, the superficial gluteal muscle transplanted 3 years previously survived and effectively supported the rectum

(Spreull and Frankland, 1980). The success rate of this technique was 64% which was lower than 81% of the standard herniorrhaphy (Weaver and Omamegbe, 1981).

**Use of the semitendinosus muscle flap**

This technique has been reported in a dog with bilateral PH which recurred after surgery at the ventral area (Chambers and Rawlings, 1991). The rectal sacculation with fecal accumulation was observed. Physical and rectal examinations 15 months after surgery revealed normal finding. A skin incision is extended from the caudal border of the ischiatic tuberosity to the caudal aspect of the distal third of the left thigh. The muscle is cut at midbelly and reflected to cover both sides of the ventral herniated area. The distal end of the muscle flap is secured with the right internal obturator muscle. The lateral side of the flap is secured with the fascia lining the dorsal border of the ischiatic tuberosity.

**Placement of prosthetic implants**

Use of synthetic and biological materials for the correction of PH in dogs has been reported. The implant can be applied through either the perineal or abdominal approach. Clarke (1989) placed and secured a polypropylene mesh, the synthetic material, with the coccygeus muscle dorsally and laterally, sacrotuberous ligament laterally, tuber ischii and fascia of the internal obturator muscle ventrally, and external anal sphincter medially in seventeen dogs. Each suture was tied loosely and 2 long ends of each suture were secured with the mesh. Two long ends are used to appose the lateral and medial borders of the mesh with the adjacent tissue. Suture sinuses developed in two dogs 2 months postoperatively. The sinuses were associated with polypropylene suture and resolved after the sutures had been removed. The recurrence was found at the ventral side in only one dog. There was another report on using the polypropylene mesh in addition to the internal obturator transposition in 36 dogs with the recurrence and overall success rates of 12.5% and 80.5%, respectively (Szabo et al., 2007). Application of the polypropylene mesh is limited in case that the internal obturator muscle is weak and friable to hold the sutures. No recurrence of PH

was found when the mesh was secured with the pelvic bone. The advantage of this technique is the strong support at the ventral side (Vnuk et al., 2006).

Use of a small sheet of porcine dermal collagen derived from dermal layer of pig skin for PH repair has been reported with a success rate of 59.3% in dogs (Frankland, 1986). The dermal layer is cut into 0.6 mm thickness, depilated by chemical solution, and immersed in enzyme bath to remove all non-collagen elements. Glutaraldehyde was used for slow rate of absorption. Before using the collagen sheet, sutures were preplaced dorsally from the external anal sphincter to the coccygeal muscle, and/or fascia adjacent to the base of the tail, and ventrally from the external anal sphincter to fascia and the internal obturator muscle. The sheet of porcine dermal collagen is cut to the appropriate size and secured with the preplaced sutures at the external anal sphincter, the coccygeal, and internal obturator muscles.

Use of porcine small intestinal submucosa (PSIS), a biological material, for repairing PH was compared with TIOM in relation to postoperative complications, biomechanical testing, and histological examination. There were no significant differences of postoperative complications, graft failure, anal displacement, and stiffness. However, the histological examination of the TIOM group at 2 weeks revealed inflammation, mineralization, and necrosis, which were not present in the PSIS group. Nevertheless, histological examination at 12 and 16 weeks did not show any differences in cell population and tissue characteristics between the 2 groups. This study suggests that PSIS can be used when the internal obturator muscle is friable or in recurred cases (Stoll et al., 2002).

**Placement of autogenous grafts**

According to Bongartz et al. (2005), an autogenous fascia lata graft (FLG) was harvested and stored in a sterile saline soaked sponge. The graft was sutured directly to the ischiourethralis ventromedially, periosteum of the ischium ventrally, ventral part of the levator ani muscle and caudal part of the external anal sphincture medially, and sacrotuberous ligament laterally. There was no recurrence during a mean follow –up of 5.8 months. Lameness was the minor complication and resolved spontaneously. The

histopathological examination in 1 dog showed incorporation of FLG with the adjacent tissues without significant tissue reaction.

**Use of tunica vaginalis in urethral defect repair**

Tunica vaginalis is consisted of mesothelial cells and a connective tissue layer. The parietal layer of the tunica is attached to the inner surface of the scrotum while the visceral layer is in contact with the underlying capsule of the testis (Wrobel and Bergmann, 2006). There have been experimental studies on using tunica vaginalis as autologous, homologous and heterologous grafts. Calado et al. (2005) applied a tunica vaginalis graft on the dorsal surface of the urethral defect in rabbits. All rabbits could void urine spontaneously after surgery and retrograde urethrogram did not revealed either stricture or fistula. Inflammation degraded and finally disappeared with time after surgery. The mesothelial lining of the graft was gradually replaced by stratified epithelial lining of the native urethra. Leslie et al. (2009) used a tunica vaginalis graft and an internal preputial island flap as the onlay graft for urethroplasty in rabbit model. All rabbits could void urine spontaneously after surgery. No evidence of wound dehiscence was observed but 2 of 16 rabbits developed urethrocutaneous fistulae. Microscopic finding revealed good tissue integration and the tunica vaginalis mesothelium was gradually replaced by cells similar to those in the urothelial lining of the native urethra.

**Use of tunica vaginalis in hernia repair**

Lyophylized and glycerolized bovine parietal tunica vaginalis were used for repairing a full thickness abdominal wall defect (Hafeez et al., 2005). The effectiveness of the graft was compared with that of the expanded polytetrafluoroethylene (ePTFE) mycro mesh in a rat model. There was no significant difference in total mean values of healing tensile strength and breaking load. This bovine origin implants were gradually absorbed and replaced with recipient fibrous tissue, whereas the mesh implant was encapsulated by fibrous tissue and remained without marked changes throughout the study period. In addition, the successful use of fresh bovine tunica vaginalis for repairing umbilical hernia was observed in eight sheep (Abass, 2008). There was no

sign of graft rejection and all, except one, were completely healed. The histological examination found invasion of dense fibrous connective tissue consisting of heavy bundles of collagen fibers, neovascularization, mononuclear inflammatory cells, and melanin deposition.

**Use of tunica vaginalis in perineal hernia repair**

Use of tunica vaginalis for PH repair has been reported only in one dog (Shigeo et al., 2004). The graft was inserted towards the perineum through the inguinal ring and the abdominal cavity. The patient had uneventful recovery with no recurrence or complication at 5 years after surgery.

**Additional procedures**

Colopexy is used fundamentally to repair severe rectal dilation or recurrent rectal prolapse. A midline celiotomy and left-sided paramedian abdominal wall incision are performed. The colon is pulled cranially and stay sutures are placed. A longitudinal incision is made through serosa layer on the anti-mesenteric border of the descending colon in the apposition to the proposed incision on the abdominal wall. Then, the two incisions were apposed with simple interrupted sutures (Bellenger and Canfeild, 2002).

Cystopexy is a supportive procedure for the treatment of bladder retroflexion (Hosgood et al., 1995). Cystopexy is temporarily currative procedure that can not solely prevent recurrent bladder retroflexion. Therefore, hernia correction is required. Cystopexy creates permanent adhesion between the bladder and right paramedian abdominal wall by simple interrupted sutures (Bellenger and Canfeild, 2002).

**Complications**

Wound infection after standard herniorrhaphy has been recorded at 13% (Weaver and Ommamegbe, 1981), 20% (Bellenger, 1980), and 26% (Burrows and Harvey, 1973). The most commonly identified organism is *Escherichia coli*. Others organisms occasionally found in wound infection include *Proteus*, *Staphylococcus*, *Klebsiella*, and *Bacteroides* species. Risk of infection can be reduced by minimal traumatic surgical technique. If wound infection occurs, the ventral stitches must be

removed to allow irrigation and drainage. Antibiotic therapy is based on bacterial culture and sensitivity result (Bellenger and Canfeild, 2002).

Fecal incontinence may result from decrease of the external anal sphincter function caused by damage of the pudendal nerve or caudal rectal nerve (Bellenger and Canfeild, 2002). Severity of the nerve trauma affects duration of functional recovery. Generally, permanent fecal incontinence results from bilateral nerve damage. Tenesmus may occur due to suturing through the rectal wall. It will resolve with time after removal of the suture.

Rectal prolapse is the common transient problem which responds to sedation. If the dog does not respond to sedation, temporary purse-string placement should be performed. In case of recurrent rectal prolapse, colopexy or colon resection may necessitate (Bellenger and Canfeild, 2002).

Urinary tract malfunctions may be found due to urinary bladder retroflaxion that can cause neurological injury. The clinical sign includes urinary incontinence which is commonly transient and normal bladder function can return within 1 week though incontinence may remain in some dogs (Bellenger and Canfeild, 2002).

Sciatic nerve paralysis caused by penetrating or entrapping the nerve during placing sutures craniolaterally around the sacrotuberous ligament. Nerve trauma causes temporary or permanent lameness, marked pain, and nonweight bearing. The stitches must be removed. Recovery may take several weeks to months and may not be completed (Bellenger and Canfeild, 2002).

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# Chapter III

# Materials and Methods

## Animals

The animals enrolled in this study were 20 intact male dogs with PH that were not candidates of the standard herniorrhaphy because of marked thin or friable pelvic diaphragm muscles or a large hernial ring with massive herniated contents. The hernias occurred bilaterally and unilaterally in 5 and 15 dogs, respectively. All were surgical treated by the same surgeon at Small Animal Hospital, Faculty of Veterinary Science, Chulalongkorn University. Study protocol were reviewed and approved by Animal Care and Use Committee of Chulalongkorn University. Before surgery, the owners were informed about the technique and occasional postoperative complications and agreed to complete the follow-up evaluation. Signalment, clinical signs, duration and side of PH, and concurrent abnormalities were recorded. Complete blood count and serum chemistry were examined before anesthesia. The herniated organs, rectum, and prostate gland were examined radiographically and per rectum.

## Equipments

1. Surgical instruments
2. Equipments and drugs for general and epidural anesthesia
3. Anesthetic machine
4. Indirect blood pressure measuring equipment
5. Pulseoximeter
6. ECG monitoring equipment
7. Radiographic machine
8. Equipments for pneumocolon radiography
9. Stethoscope
10. Photographic equipment

**Materials and Methods**

1. Anesthesia

The dogs had been physically examined before intramuscular premedication with acepromazine (Combistress®, Phenix, Belgium) 0.02 mg/kg and morphine (Morphine sulfate injection, the Food and Drug Administration, Thailand) 0.4 mg/kg was given to dogs without heart diseases. Dogs with heart diseases or older than 7 years were premedicated with intramuscular midazolam (Domicum®, Roche, France) 0.2 mg/kg and morphine 0.4 mg/kg. The animals were intubated and general anesthesia was induced to effect intravenously with propofol (1% Propofol® Emulsion, Fresenius Kabi, Austria). Anesthesia was maintained with isoflurane (Forane®, ABBOTT, England) in oxygen and epidural bupivacaine (Marcain®, AstraZeneca, Australia) 2 mg/kg and morphine 0.1 mg/kg. Enrofloxacin (Baytril®, Bayer HealthCare LLC, USA) 5 mg/kg was administrated subcutaneously before surgery. Anesthetic depth, heart rates, respiratory rates, $O_2$ saturation, blood pressures, and electrocardiography were monitored every 5-15 minutes during surgery until complete recovery.

2. Radiography

Plain and contrast radiographs of the caudal abdomen and perineal area were taken to identify the herniated organs and concurrent abnormalities. For contrast radiographs, pneumocolon, a Foley catheter was inserted through the anus into the rectum and fixed in place with a purse-string suture and the catheter's balloon filled with normal saline solution (Fig. 1). Air, 10 ml/kg, was inflated into the rectum and colon lumen through the Foley tip set (Fig. 2). Radiographs were taken immediately after air at an appropriate volume had been inflated into the rectum and colon (Fig.3).

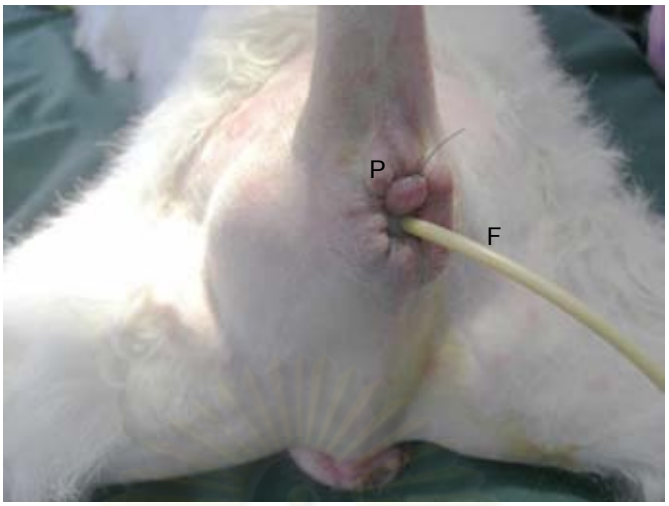


**Figure 1**. A Foley (F) inserted into the rectum and fixed in place with a purse-string suture (P) and the catheter's balloon filled with normal saline solution.

**Figure 2**. A Foley connected with a 3-way stop-cock attached to a syringe for air inflation.

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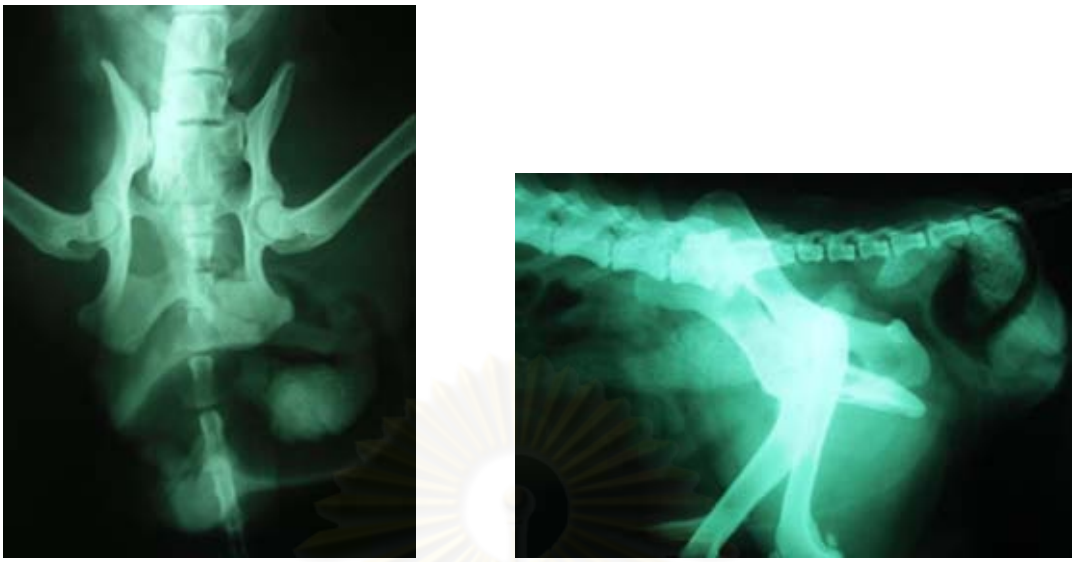

**Figure 3**. Ventrodorsal and lateral radiographs of the caudal abdomen taken immediately after air inflated into the rectum and colon.

Urethra was catheterized with care in case of retroflexed urinary bladder that partially or completely obstructed the urethra. In case that the catheterization was unsuccessful, perineal cystocentesis was performed to empty the urine.

3. Surgical procedures

3.1 Preparation of the surgical area

Skin at the prescrotal area, perineal area, and left caudal abdomen (in case of colopexy was indicated) was clipped and cleaned for surgery with chlohexidine, povidone iodine, and ethyl alcohol.

3.2 Castration and tunica vaginalis preparation

The dog was positioned in dorsal recumbency. The prescrotal area was draped and the scrotum was excluded from the surgical field. The scrotum was manipulated to displace the testicles to the prescrotal area. Skin and subcutaneous tissue were incised on the median raphe over the displaced testicles and one of the testicles was exteriorized. The fibrous attachment between the spermatic cord tunic and scrotum was incised. Fat and fascia were bluntly dissected free from the parietal tunic to maximally exteriorize the spermatic cord. The spermatic cord was clamped with the artery forceps to mark the ligature site where would be tied with the

multifilament absorbable polyglactin 910 (Vicryl™, Ethicon Inc., Belgium) suture. The spermatic cord was cut between the ligatures and another artery forceps. The cord was inspected for hemorrhage and placed back to the inguinal canal. The other testicle was brought out through the incision and removed as previously described. Tunica vaginalis sheet was harvested by cutting along the greater curvature and preserved in normal saline solution (normal saline solution, NSS, Plabottle®, Otsuka, Thailand) (Fig. 4).


**Figure 4**. A) Testis with tunica vaginalis (TV) after castration. B) The TV was cut along the greater curvature. C) The harvested TV graft.

Unilateral testicular tumor in 2 dogs was removed and send to histopathological examination.

Subcutaneous tissue was sutured to reduce a dead space with 2/0-3/0 monofilament absorbable polydioxanone (PDS™II, Ethicon Inc., Belgium). Skin was closed with 2/0-3/0 monofilament non-absorbable polyamide (Dafilon®, B/BRAUN, Germany)

3.3 Tunica vaginalis autotransplantation

The dog was positioned in sternal recumbency and the perineal area was draped. A dorsoventral skin incision was made over the hernia, extending from the lateral tail base down to the medial angle of the ischial tuberosity. The hernia sac was partially excised and the herniated organs were explored and returned to their normal location (Fig. 5). In case of prostatic cysts or abscesses, the prostatic size was reduced by aspiration of the fluid using needle and syringe (Fig. 6). The fluid from the diseased prostate was sent for bacterial culture and sensitivity test.

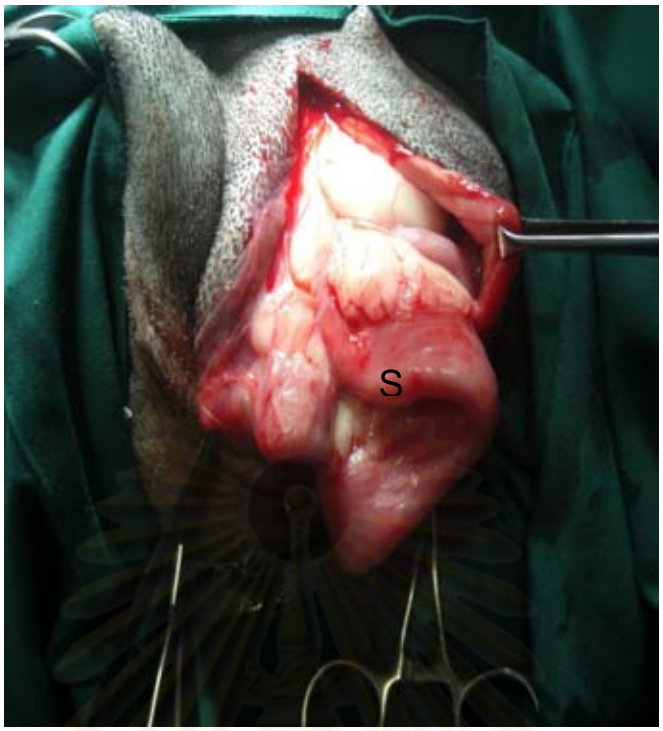


**Figure 5**. Herniated small intestine (S).


**Figure 6**. Aspiration of the prostatic abscess (P).

The internal pudendal artery, vein, and pudendal nerve were identified and avoided during suturing. The external anal sphincter, rectum, sacrotuberous ligament, coccygeal, internal obturator, and levator ani muscles were exposed. The harvested tunica vaginalis was inserted under the coccygeal muscle (Fig. 7).

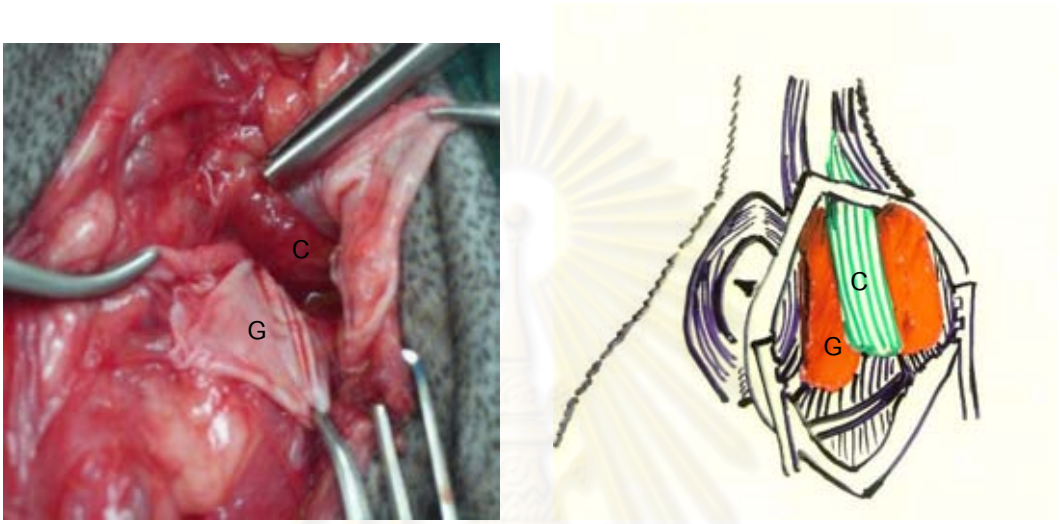


**Figure 7**. The tunica vaginalis graft (G) inserted under the coccygeal muscle (C).

Four to 5 simple interrupted sutures of 0 – 2/0 monofilament non-absorbable polypropylene material (Prolene™, Ethicon Inc., Belgium) were preplaced to anchor the graft with the external anal sphincter, sacrotuberous ligament, and internal obturator muscle (Fig. 8). Then, the preplaced sutures were tied. Sterile normal saline solution was used for wound irrigation before closing. Tissue dead space was reduced by simple interrupted suture of 2/0-3/0 monofilament absorbable polydioxanone. The subcutaneous tissue was sutured using absorbable material of 2/0-3/0 polydioxanone. Skin was closed with 2/0-3/0 monofilament non-absorbable polyamide. perineal fat tumor in 1 dogs was removed and send to histopathological examination.


**Figure 8**. Four to 5 sutures anchoring the TV graft (G) with the sacrotuberous ligament (S) and external anal sphincter (E).

3.4 Transposition of the internal obturator muscle (TIOM)

In case of very weak pelvic diaphragm and the hernia ring extendto the ventral of the anus, TIOM was additionally performed. The internal obturator muscle was incised along the dorsocaudal border of the ischial tuberosity and elevated subperiosteally as cranial as the caudal limit of the obturator foramen. Two to four simple interrupted sutures were preplaced between the internal obturator muscle and ventral rim of the TV graft. One suture was preplaced through the caudal portion of the external anal sphincter, ventromedial rim of the TV graft, and internal obturator muscle. One suture was preplaced through the sacrotuberous ligament, internal obturator muscle, and ventrolateral rim of the TV graft. Then, all preplaced sutures were tied. Sterile normal saline solution was used for wound irrigation before closing. Tissue dead space was reduced by simple interrupted suture of 2/0-3/0 monofilament absorbable

polydioxanone. The subcutaneous tissue was sutured using absorbable material of 2/0-3/0 polydioxanone. Skin was closed with 2/0-3/0
monofilament non-absorbable polyamide. Contrast radiographs were taken postoperatively to examine rectal conformation.

3.5 Colopexy

Colopexy (Bellenger and Canfield, 2002) was indicated in case of a very large PH, massive bowel herniation, recurrence, or rectal prolapse. A midline celiotomy through a left-sided paramedian abdominal wall incision was made. The descending colon was pulled cranially to reduce rectal deviation or prolapse. Two stay sutures of 2/0 monofilament absorbable polydioxanone were placed at the rectum. An incision was made longitudinally along the antimesenteric border between the stay sutures through the seromuscular layer of the colonic wall. Another incision was made on the left abdominal wall at the position approximate to the incision on the rectum. Edges of the incision at the colon and abdominal wall were apposed with 3 to 4 simple interrupted sutures of 2/0 or 3/0 monofilament non-absorbable material (nylon or polypropylene). Simple interrupted sutures of 2/0-3/0 monofilament absorbable polydioxanone were applied to close the muscle sheath. Tissue dead space was reduced by simple interrupted suture of 2/0-3/0 monofilament absorbable polydioxanone. The subcutaneous tissue was sutured by subcuticular pattern of absorbable material of 2/0-3/0 polydioxanone while skin was closed by simple interrupted pattern of 2/0-3/0 monofilament non-absorbable polyamide.

3.6 Cystopexy

Cystopexy (Gilley et al., 2003) was performed through the same incision of colopexy. A stay suture of 3/0 monofilament nonabsorbable material (nylon or polypropylene) was placed at the apex and cranial traction on the bladder was applied until the bladder was located in the normal position. The areas to be sutured on serosa of the ventral wall of the urinary bladder and on the peritoneum at the right side of the abdominal wall were lightly abraded with gauze sponge. Partial thickness suturing of the bladder wall with simple interrupted sutures of 2/0-3/0 monofilament non-absorbable polypolypropylene was applie

4. Postoperative management

The animals received enrofloxacin 5 mg/kg for 7 days and tramadol 4 mg/kg for 5 days. Wound was cleaned and observed for swelling, seroma, dehiscence, hematoma, and infection. Defecation was subjectively assessed as normal or tenesmus by the dog owners. In case of no complications, stitches were removed at day 10 after surgery.

5. Monitoring period

The follow-up was made by telephone call every 2 to 4 weeks. The questionnaire was used as a tool of collecting the data. In case of prostatic cyst or abscess, ultrasound was performed to confirm and guide prostatocentesis. The dogs were evaluated every 2-4 weeks depending on severity of the concurrent abnormalities. Radiographs and contrast radiography were indicated in the case that rectal disorder or defecation difficulty remained.

**Data Collection and Analysis**

1. Blood profiles

Blood was collected for complete blood count, blood chemistry (alanine aminotransferase or SGPT, alkaline phosphatase or ALP, blood urea nitrogen, and creatinine) , and blood parasite investigation before surgery.

2. Clinical signs

Clinical signs including depression, vomiting, diarrhea, anorexia, abnormal defecation, abnormal urination, duration of disease, hernia side, and herniated organs, were recorded.

3. Plain and contrast radiographs

Plain and contrast radiographs were taken before surgery for herniated organ and concurrent rectal disease investigation.

4. Surgical procedure and time

Surgical procedure, tunica vaginalis autografting with or without transposition of internal obturator muscle, and time spending in all dogs were recorded.

5. Bacterial culture and sensitivity test

In dogs with prostatic cyst or abscess, the aspirated fluid or pus was sent for bacterial culture and sensitivity test.

6. Tissue collection and histopathological examination

For the perineal and testicular mass, the removed mass was preserved in 10% formalin for histopathological examination.

7. Graft collection and histopathological examination

Tunica vaginalis graft was collected from the recurred case and preserved in 10% formalin for histopathological examination.

8. Recurrence and complications

Recurrence rate and complications including wound infection, fecal incontinence, tenesmus, rectal prolapse, and sciatic nerve paralysis, were recorded.

9. Statistic analysis

Descriptive statistic was used for analyzing the result in relation to signalment, clinical signs, blood parameters between the dogs with and without urinary bladder retroflexion and between the dogs with and without prostatomegaly, radiographic findings (including rectal abnormalities), surgical time, success rate, recurrence rate, defecation and urination problems after surgery, and other complications.

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# Chapter IV

# Results

## Signalment

Twenty intact male dogs were 8 mixed-breed dogs, 5 Shih Tzus, 4 Poodles, 2 Cocker spaniels, and 1 Yorkshire Terrier (Table 1). Means (±SD) of animal age and body weight were 9.45 (±2.40) years (range, 5-13 years) and 8.59 (±4.55) kg (range, 2.6-18.30 kg), respectively. Mean (±SD) duration of herniation was 4.13 (±3.36) months (range, 1-12 months).

## Clinical signs

Clinical signs included perineal swelling (20/20), depression (4/20), anorexia (7/20), vomiting (2/20), abdominal clamp (3/20), urination problems (6/20), and defecation problems (19/20) (Figure 9, Table 1). Six dogs with the urination problems were 6 of 7 dogs with the retroflexed urinary bladder. The defecation problems included tenesmus (14/20), dyschezia (2/20), hematochezia (1/20), and defecation difficulty (4/20).

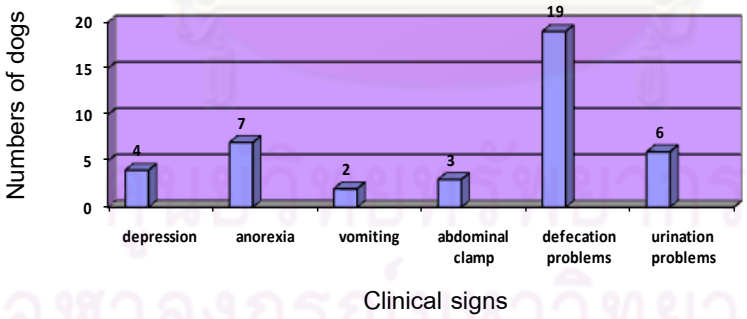


**Figure 9.** Numbers of the dogs showing various clinical signs

**Table 1.** Signalment, clinical signs, and concurrent diseases

| Dog No. | Breed | Age (years) | Body weight (kg) | General clinical signs | Defecation | Urination | Prostatic diseases | Other concurrent diseases |
|---|---|---|---|---|---|---|---|---|
| 1 | Mixed | 11 | 14.7 | None | Tenesmus | None | Prostatomegaly (Prostatic cyst) | Tumor of perineal fat (liposarcoma) |
| 2 | Mixed | 10 | 4.85 | Depression, anorexia | Tenesmus, dyschezia, and constipation | Dysuria and tenesmus | None | None |
| 3 | Mixed | 12 | 6.75 | None | Tenesmus | Hematuria, dysuria, and tenesmus | Prostatomegaly (Prostatic abscess) | None |
| 4 | Shih tzu | 5 | 6.80 | None | Hematochezia | None | Prostatomegaly | None |
| 5 | Mixed | 5 | 12.5 | None | Tenesmus | None | None | None |
| 6 | Poodle | 10 | 6.55 | Anorexia, vomiting | Tenesmus | None | None | None |
| 7 | Mixed | 9 | 15.7 | None | Strain and soft feces | None | None | None |
| 8 | Mixed | 13 | 6.90 | None | Strain | None | None | Rt. Testicular tumor (seminoma) |
| 9 | Poodle | 10 | 9.50 | Depression, anorexia | Tenesmus | Hematuria | None | None |
| 10 | Mixed | 11 | 6.55 | None | Strain | None | None | None |

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**Table 1.** Signalment, clinical signs, and concurrent diseases (continue)

| Dog No. | Breed | Age (years) | Body weight (kg) | General clinical signs | Defecation | Urination | Prostatic diseases | Other concurrent diseases |
|---|---|---|---|---|---|---|---|---|
| 11 | Cocker spaniel | 8 | 18.3 | None | Strain | None | None | Lt. testicular tumor (Intratubular seminoma) |
| 12 | Shih tzu | 6 | 6.15 | None | Tenesmus and constipation | None | None | None |
| 13 | Shih tzu | 8 | 4.05 | Vomiting | Tenesmus and constipation | None | Mild prostatomegaly | None |
| 14 | Mixed | 10 | 16.4 | Mild abdominal clamp | Tenesmus and constipation | None | Mild prostatomegaly | None |
| 15 | Yorkshire terrier | 12 | 2.60 | Mild anorexia | None | None | Mild prostatomegaly | None |
| 16 | Shih tzu | 9 | 5.15 | Depression, anorexia, mild abdominal clamp | Tenesmus and dyschezia | Tenesmus | Moderate- severe prostatomegaly | None |
| 17 | Cocker spaniel | 13 | 10.75 | Depression, anorexia, abdominal clamp | Tenesmus and constipation | Tenesmus | Mild prostatomegaly | None |
| 18 | Poodle | 11 | 5.15 | None | Tenesmus and constipation | None | None | None |
| 19 | Poodle | 7 | 6.85 | Mild anorexia | Tenesmus and constipation | Dysuria | None | None |
| 20 | Shih tzu | 9 | 5.60 | None | None | None | Prostatomegaly (Prostatic cyst) | None |

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**Laboratory findings**

Complete blood count and serum chemistry were preoperatively evaluated in all dogs (Table 2 and 3). The laboratory result revealed leukocytosis, thrombocytopenia, anemia, azotemia, elevated SGPT, and elevated ALP in 9, 8, 4, 3, 3, and 2 dogs, respectively. The 9 dogs (dogs 2, 3, 4, 6, 8, 9, 11, 12, and 19) with leukocytosis were 1 dog (dogs 3) with both UB retroflexion and prostatomegaly, 3 dogs (dogs 2, 9, and 19) with UB retroflexion, 1 dog (dog 4) with prostatomegaly, and 4 dogs (dogs 6, 8, 11, and 12) with neither UB retroflexion nor prostatomegaly. Azotemia was found in 6 dogs (dogs 1, 8, 9, 10, 17, and 19) in which 3 (dogs 1, 9, and 17) had an increased creatinine. Of the latter 3 dogs, 1 each had only UB retroflexion (dog 9), only prostatomegaly (dog 1), and both UB retroflexion and prostatomegaly (dog 17.)

**Table 2.** Number of dogs with and without urinary bladder (UB) retroflexion and with and without prostatomegaly associated with perineal hernia that had increased preoperative blood urea nitrogen (BUN), creatinine, and WBC.

| Parameters (normal range) | Of 7 dogs with UB retroflexion (dogs) | Of 13 dogs without UB retroflexion (dogs) | Of 9 dogs with prostatomegaly (dogs) | Of 11 dogs without prostatomegaly (dogs) |
|---|---|---|---|---|
| Increased BUN (6-27mg%) | 3 (dogs 9, 17, and 19 ) | 2 (dogs 1 and 10) (NR 1 dog) | 2 (dogs 1 and 17) | 3 (dogs 8, 9, and 19) (NR 1 dog) |
| Increased creatinine (0.62-1.64 mg%) | 2 (dogs 9 and 17) | 1 (dog 1) | 2 (dogs 1 and 17) | 1 (dog 9) |
| Increased WBC (6,000-17,000 per µl) | 4 (dogs 2, 3, 9, and 19) | 5 (dogs 4, 6, 8, 11, and 12) | 2 (dogs 3 and 4) | 7 (dogs 2, 6, 8, 9, 11, 12, and 19) |

NR - no report

**Table 3.** Preoperative complete blood count and blood chemistry

| Dog No. | RBC ($x10^6$per µl) | HCT (%) | Hb (g/dl) | PLT (per µl) | WBC (per µl) | Neu (per µl) | Band (per µl) | Eo (per µl) | Lym (per µl) | Mono (per µl) | SGPT (Unit) | ALP (Unit) | BUN (mg%) | CR (mg%) | Blood parasite |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 53 | 18 | 236000 | 9000 | 6750 | 90 | 720 | 1260 | 180 | 102 | 44 | 50 | 2.0 | NF |
| 2 | 4 | 25 | 9.1 | 440000 | 23000 | NR | NR | NR | NR | NR | 199 | 114 | 16 | 0.9 | NF |
| 3 | 6 | 50 | 17 | 191000 | 18000 | 14400 | 180 | 1260 | 1620 | 540 | 34 | 42 | 11 | 0.6 | NF |
| 4 | 7 | 50 | 17 | 88000 | 26800 | 17956 | 268 | 804 | 6164 | 1608 | 34 | 40 | 18 | 0.8 | NF |
| 5 | 7 | 58 | 18 | 268000 | 9400 | 6580 | 0 | 658 | 1692 | 470 | 14 | 51 | 15 | 1.1 | NF |
| 6 | 7.2 | 55 | 18.6 | 385000 | 18600 | 14694 | 744 | 936 | 1302 | 744 | 76 | 82 | 23 | 0.8 | NF |
| 7 | 6 | 44 | 15 | 224000 | 10200 | 8058 | 204 | 0 | 1632 | 306 | 36 | 60 | 10 | 1.4 | NF |
| 8 | 6 | 46 | 15 | 130000 | 17600 | 10912 | 0 | 3520 | 2640 | 528 | 75 | 100 | 18 | 0.7 | NF |
| 9 | 6.6 | 53 | 18 | 228000 | 20000 | NR | NR | NR | NR | NR | 57 | 159 | 62 | 4.3 | NF |
| 10 | 6.7 | 48 | 16 | 221000 | 10000 | 7700 | 0 | 0 | 2000 | 300 | 180 | 30 | 42 | 1.2 | NF |
| 11 | 4.9 | 33 | 11.8 | 134000 | 21200 | 15264 | 0 | 848 | 4876 | 212 | 36 | NR | NR | 1.1 | NF |
| 12 | 6 | 42 | 14 | 463000 | 17500 | NR | NR | NR | NR | NR | 88 | 92 | 16 | 0.5 | NF |
| 13 | 5.6 | 39 | 12 | 415000 | 7400 | 4662 | 0 | 888 | 1480 | 370 | 40 | 33 | 15 | 0.6 | NF |
| 14 | 5.4 | 43 | 14 | 178000 | 15200 | 8816 | 0 | 0 | 5168 | 1216 | 34 | 40 | 15 | 1 | NF |
| 15 | 7.6 | 51 | 17 | 333000 | 8100 | 5832 | 81 | 144 | 1620 | 405 | 56 | 20 | 16 | 0.6 | NF |
| 16 | 8.8 | 49 | 17.2 | 293000 | 6200 | 2604 | 0 | 0 | 3038 | 558 | 3 | 821 | 16 | 0.6 | NF |
| 17 | 3.4 | 24 | 8 | 153000 | 16800 | 14280 | 1008 | 672 | 504 | 336 | 28 | 46 | 86 | 2.4 | NF |
| 18 | 7.5 | 48 | 16 | 156000 | 8100 | 5265 | 0 | 162 | 2349 | 324 | 25 | 793 | 22 | 0.6 | NF |
| 19 | 6 | 39 | 12 | 48000 | 22400 | 13440 | 0 | 3360 | 4704 | 896 | 46 | 70 | 36 | 0.8 | NF |
| 20 | 8.2 | 51 | 18.1 | 260000 | 10800 | 8208 | 0 | 0 | 1296 | 1296 | 149 | 54 | 22 | 0.7 | NF |

NR - no report, NF - not found

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### Radiographic findings

Survey radiographs were taken preoperatively in all dogs to evaluate the herniated organs and concurrent abnormalities. The herniated organs consisted of rectum (17/20, 85%), small intestine (3/20, 15%), urinary bladder (7/20, 35%) and prostate gland (2/20, 10%). Rectal deviation, dilation, and sacculation were found in 13, 8, and 5 dogs, respectively. Prostatomegaly was detected in 9 dogs (45%) (Table 1).

### Surgical procedures

Unilateral hernia occurred in 15 dogs (Table 4) (dogs 1, 4, 5, 6, 8, 9, 10, 11, 12, 14, 15, 17, 18, 19, and 20). Herniorrhaphy used tunica vaginalis autografting (TVG) in 10 dogs (dogs 1, 4, 5, 6, 8, 9, 10, 12, 14, and 15), TVG plus TIOM in 3 dogs (dogs 11, 19 and 21), and TVG plus colopexy and cystopexy in 2 dogs (dogs 17 and 19) (Figure 10). Bilateral hernias occurred in 5 dogs (dogs 2, 3, 7, 13, and 16). TVG was used on both sides in 2 dog (dogs 2 and 13) while TVG together with TIOM was used on both sides in 1 dog (dog 7). One dog (dog 3) received TVG on one side and standard herniorrhaphy on the other side. The last dog (dog 16) received TVG on one side and none on the other side. Mean (±SD) of the surgical time of TVG, excluding the dog with perineal tumor, was 63.8 (±21.5) minutes (range, 30-110 minutes) and mean (±SD) of the surgical time of TVG plus TIOM was 76.0±20.4 minutes (range, 55-100 minutes). Prostatocentesis was performed in 1 dog (dog 3) with prostatic abscess to reduce prostate size.


**Figure 10.** Surgical procedures used for unilateral and bilateral PH repairs.

**Follow-up evaluation**

Dog 8 died 2 and a half months after the unilateral PH corrected solely by the tunica vaginalis autografting. This dog was one of the two dogs having the testicular tumor. Cause of death did not relate with the surgical treatment and the hernia did not recur. This dog was excluded leaving 19 dogs and 22 hernias for data analysis. The mean follow-up time was 8.51 (±3.61) months. The follow-up time of more than 12, 6, and 3 were from 5, 10, and 4 dogs, respectively.

Success of the tunica vaginalis autografting was observed in 15 of 17 PH (88.23%) repaired by the autografting alone and 5 of 5 PH (100%) receiving the autografting in conjunction with TIOM. Recurrence was found in 2 of 17 PH (11.77%) receiving the autografting alone and none of 5 PH (0%) receiving the autografting together with TIOM. The PH recurred at the ventral perineum in dog 2 receiving only the autografting at 10 days and in dog 19 receiving the autografting and colopexy at 2 months after surgery (Table 5). Clinical signs started from mild difficult defecation, straining, and then reherniation. The herniated organs were the urinary bladder and prostate gland in dog 2 and only the urinary bladder in dog 19. Both dogs had dysuria and urinary incontinence. The surgical treatment of the recurred PH in dog 2 was performed 3 weeks after the first repair. The pelvic diaphragm muscles were markedly thin and biting of the stitches securing the graft with the internal obturator muscle was observed. The graft was resutured in place after tissue at the apposing area between the graft and the adjacent tissues had been biopsied for histopathological examination. Two and a half months later, the hernia recurred with herniation of the urinary bladder, small intestine, and rectum. Rectal examination found moderate dilation of the caudal rectum. Colopexy, cystopexy, and vasopexy were performed at the 3$^{rd}$ repair. The reherniation occurred and utilization of a polypropylene mesh was planned for the fourth repair. However, the dog's owner refused the treatment plan because the animal could defecate and needed periodic enemas. In dog 19, the second surgery was performed 3 weeks after the recurrence. Biting of the stitches securing the graft with the internal obturator muscle was observed. The tissue at the apposing area between the graft and

the adjacent structure had been biopsied for histopathological examination before the graft was resutured in place. The dog had normal urination and defecation afterwards.

Rectal abnormalities were diagnosed from negative contrast colonography (pneumocolon) at pre- and postoperation (Figure 11 and 12). Preoperative radiographs revealed rectal prolapse, deviation, dilation, and sacculation in 1, 13, 8, and 5 dogs, respectively (Figure 13). These occurred as single abnormality or in combination. Immediate postoperative radiographs revealed 8 sides of rectal dilation (with marked improved in 2 sides, slight improved in 1 side, and still dilated in 5 sides) and 5 sides of rectal sacculation (all improved)(Table 5). The dogs with rectal deviation or rectal prolapse were resolved postoperatively. Ten days after surgery, 15 dogs had no defecation difficulty, dyschezia, or tenesmus while 4 dogs had mild defecation difficulty. However, at 3 months after surgery, there was only 1 dog with mild defecation difficulty.

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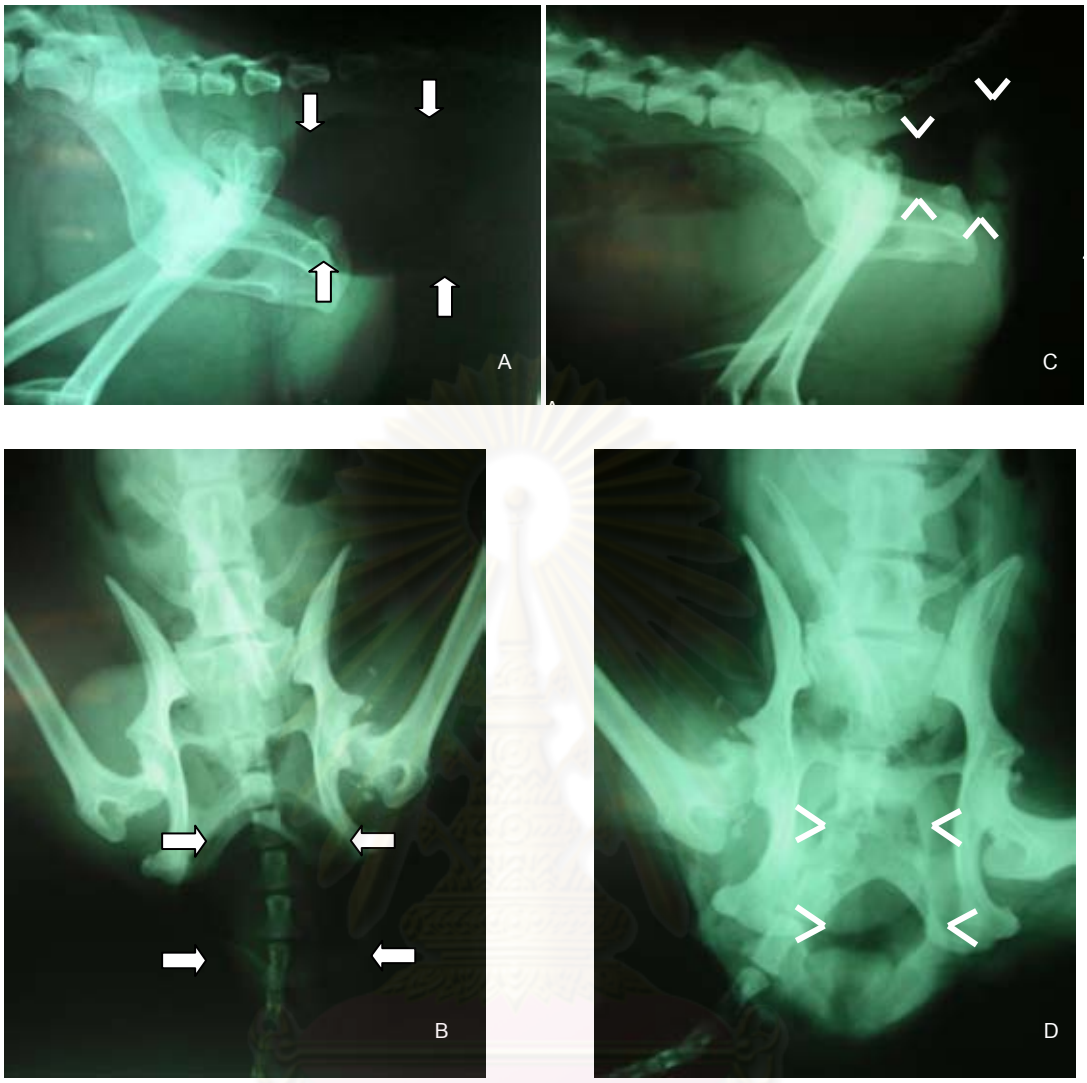


**Figure 11.** A. and B., Preoperative left lateral and ventrodorsal abdominal contrast radiographs showed rectal dilation (white arrows). C. and D., Immediate postoperative left lateral and ventrodorsal abdominal contrast radiographs showed improvement of rectal alignment and decrease in rectal size (arrow heads).

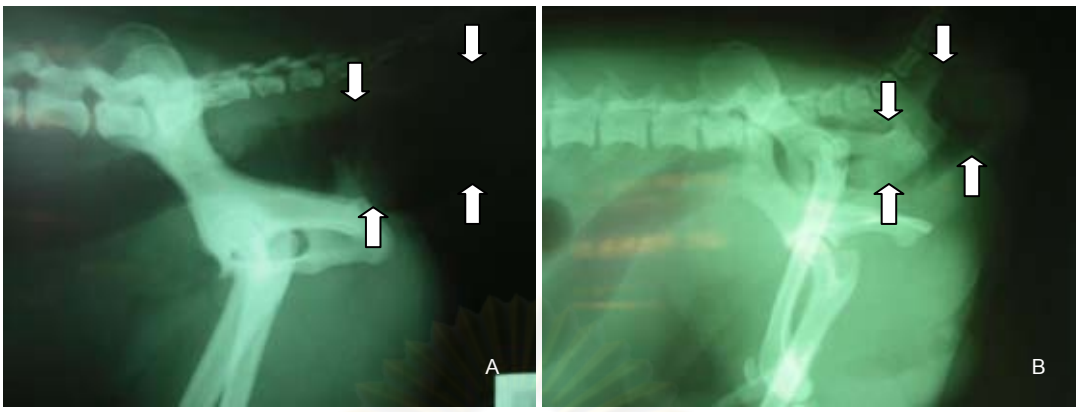


**Figure 12.** A., Preoperative left lateral contrast radiograph showed rectal deviation. B., Immediate postoperative left lateral contrast radiograph showed an improvement of rectal alignment (white arrows).

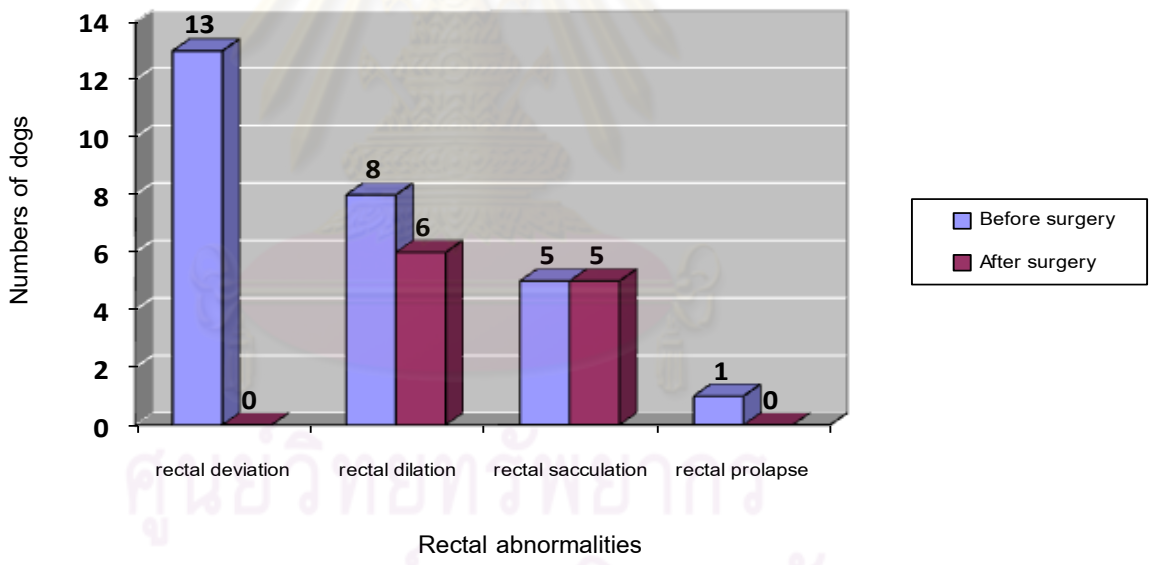


**Figure 13.** Preoperative and postoperative rectal abnormalities.

**Table 4.** Description of hernias and surgical procedures

| Dog No. | Side of hernia | Herniated organs | Duration of hernia (months) | Surgical procedure | TVG time (minutes) |
|---|---|---|---|---|---|
| 1 | Left | Rectum,fat | 7 | TVG +perineal tumor removal | 165 |
| 2 | Both | Rt: small bowel, rectum | 8 | Rt: TVG | Rt: 75 |
| | | Lt: UB, small bowel, rectum | | Lt: TVG | Lt: 60 |
| 3 | Both | Rt: UB, PG | 3 | Rt: STD | Rt: 50 |
| | | Lt: small bowel, rectum | | Lt: TVG | Lt: 70 |
| 4 | Right | Rectum | 1.5 | TVG | 75 |
| 5 | Left | Rectum | 5 | TVG | 105 |
| 6 | Left | Rectum | 2.5 | TVG | 110 |
| 7 | Both | Rt: retum | 6 | Rt: TVG+TIOM | Rt: 55 |
| | | Lt: fat | | Lt: TVG+TIOM | Lt: 55 |
| 8 | Right | Rectum | 1 | TVG | 65 |
| 9 | Right | Rectum, UB | 2 | TVG | 75 |
| 10 | Left | Rectum | 2.5 | TVG | 55 |
| 11 | Right | Rectum, fat | 12 | TVG+TIOM | 100 |
| 12 | Right | Rectum | 1 | TVG | 70 |
| 13 | Both | Rt: PG | 5 | Rt: TVG | Rt: 35 |
| | | Lt: rectum | | Lt: TVG | Lt: 30 |
| 14 | Right | Rectum | 1 | TVG | 65 |
| 15 | Right | UB | 2 | TVG | 45 |
| 16 | Both | Rt: fat | 12 | Rt: TVG | 40 |
| | | Lt: UB, rectum | | Lt: not repaired | |
| 17 | Right | UB | 2 | TVG+ CoP+CysP | 55 |
| 18 | Left | Rectum | 3 | TVG+TIOM | 80 |
| 19 | Right | UB | 2 | TVG+ CoP+CysP | 55 |
| 20 | Right | Rectum | 4 | TVG+TIOM | 90 |

Rt - right side, Lt - left side, PG - Prostate gland, UB - Urinary bladder, TVG - Tunica vaginalis autografting, STD - Standard herniorrhaphy, TIOM - Transposition of the internal obturator muscle, CoP - Colopexy, CysP - Cystopexy

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**Table 5.** Preoperative and postoperative radiographic findings of the rectum and defecation pattern.

| Dog No. | Preoperative rectal abnormalities | Postoperative rectal abnormalities | Preoperative defecation patttern | Postoperative defecation pattern | | PH repair result |
|---|---|---|---|---|---|---|
| | | | | 10days | 3 months | |
| 1 | Deviation and sacculation | Resolved deviation<br>Improved sacculation | Tenesmus | Normal | Normal | Cured |
| 2 | Deviation and dilation | Resolved deviation<br>Remained dilation | Tenesmus, dyschezia | Mild difficulty | Mild difficulty | Recurred 10 days after surgery |
| 3 | Deviation and sacculation (Rt) | Resolved deviation<br>Improved sacculaiton | Tenesmus | Normal | Normal | Cured |
| 4 | Deviation and sacculation | Resolved deviation<br>Improved sacculaiton | Hematochezia | Normal | Normal | Cured |
| 5 | Sacculation | Improved sacculaiton | Tenesmus | Normal | Normal | Cured |
| 6 | Dilation (Lt>>>Rt) | Markedly Improved dilation | Tenesmus | Normal | Normal | Cured |
| 7 | Deviation (Rt) | Resolved | Difficult | Normal | Normal | Cured |
| 8 | Sacculation | Improved sacculaiton | Difficult | Normal | Normal | Death 2.5 months after surgery |
| 9 | Deviation, dilation, and prolapse | Resolved deviation and prolapse<br>Remained dilation | Tenesmus | Normal | Normal | Cured |
| 10 | Deviation | Resolved | Difficult | Normal | Normal | Cured |

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**Table 5.** Preoperative and postoperative radiographic findings of the rectum and defecation pattern. (continue)

| Dog No. | Preoperative rectal abnormalities | Postoperative rectal abnormalities | Preoperative defecation patttern | Postoperative defecation pattern | | PH repair result |
|---|---|---|---|---|---|---|
| | | | | 10days | 3 months | |
| 11 | Deviation | Resolved | Difficult | Mild difficulty | Normal | Cured |
| 12 | Deviation | Resolved | Tenesmus | Normal | Normal | Cured |
| 13 | Deviation and dilation | Resolved deviation<br>Improved dilation | Tenesmus | Normal | Normal | Cured |
| 14 | Dilation | Remained dilation | Tenesmus | Mild difficulty | Normal | Cured |
| 15 | None | - | None | - | | Cured |
| 16 | Deviation | Resolved | Tenesmus, dyschezia | Normal | Normal | Cured |
| 17 | Dilation | Markedly improved dilation | Tenesmus | Normal | Normal | Cured |
| 18 | Deviation and mild dilation | Resolved deviation<br>Remained dilation | Tenesmus | Normal | Normal | Cured |
| 19 | Dilation | Remained dilation | Tenesmus | Mild difficulty | Normal | Recurred 2 months after surgery |
| 20 | Deviation | Resolved | Normal | Normal | Normal | Cured |

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**Postoperative complications**

The complications included wound infection, would dehiscence, sciatic nerve paralysis, and rectal prolapse. Wound infection in 3 dogs (dogs 8, 11, and 20) and wound dehiscence in 2 dogs (dogs 8 and 11) were observed. The bacterial culture from dog 11 found $\beta$-*haemolytic Streptococcus spp.* and *Klebsiella spp.* which were susceptible to amikacin, amoxicillin/clavulanic acid, and cephazolin. Non-haemolytic *Streptococcus spp.* and *Pseudomonas aeruginosa* were found in the bacterial culture from dog 20 and were susceptible to amikacin and enrofloxacin. Lameness occurred in 2 dogs (dogs 2 and 15) and resolved after removal of the sutures entrapping the sciatic nerve in dog 2. No correction was done in dog 15 according to the owner request. Rectal prolapse occurred temporarily in 1 dog during recovery period and disappeared after receiving the sedative and analgesic drugs.

**Tissue collection and histopathological examination**

Tumor of perineal fat was found in dog 1 and testicular masses in 2 dogs (dogs 8 and 11). The histopathological examination of the tumor of perineal fat revealed liposarcoma. Seminoma was found in 1 of the testicular masses and intratubular seminoma in the other.

**Graft collection and histopathological examination**

Graft biopsied from dog 2 at 3 weeks after the first herniorrhaphy had mild Zenker's degeneration and regeneration. The graft was viable and neovascularizated (Figure 14). There was regeneration of the mesenchymal cells which was the native cells of visceral layer of the tunica vaginalis. There was a subacute inflammation with accumulation of neutrophils, pus cells, and macrophages in the soft tissue surrounding the graft. Multifocal hemorrhage was also observed in the graft (Figure 15). Histopathological examination of the graft retrieved from dog 19 at 2 months and 3 weeks after first herniorrhaphy showed fibrous hypertrophy and disorderly collagen synthesis. There was regeneration of mesenchymal cells of visceral layer of the tunica

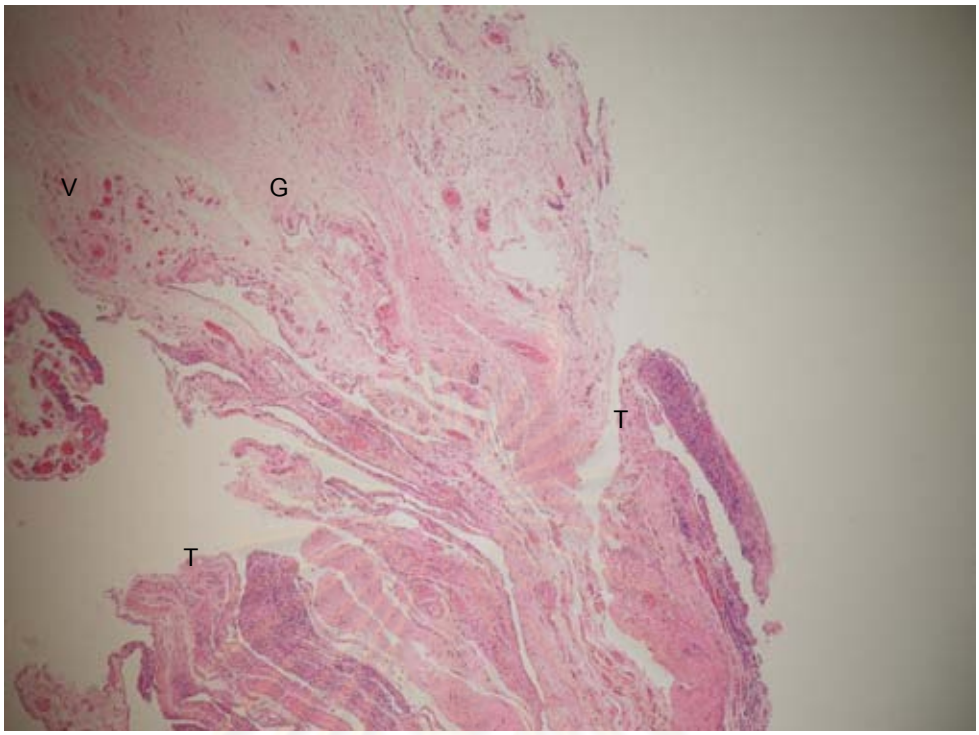


**Figure 14**. The histopathological findings of the graft biopsied from dog 2. The apposing area between the tunica vaginalis graft (G) and the adjacent tissue (T). Neovascularization (V).

vaginalis. Neovascularization was found in the graft and the adjacent tissue (Figure 16). The graft was viable and sign of graft rejection was not found.

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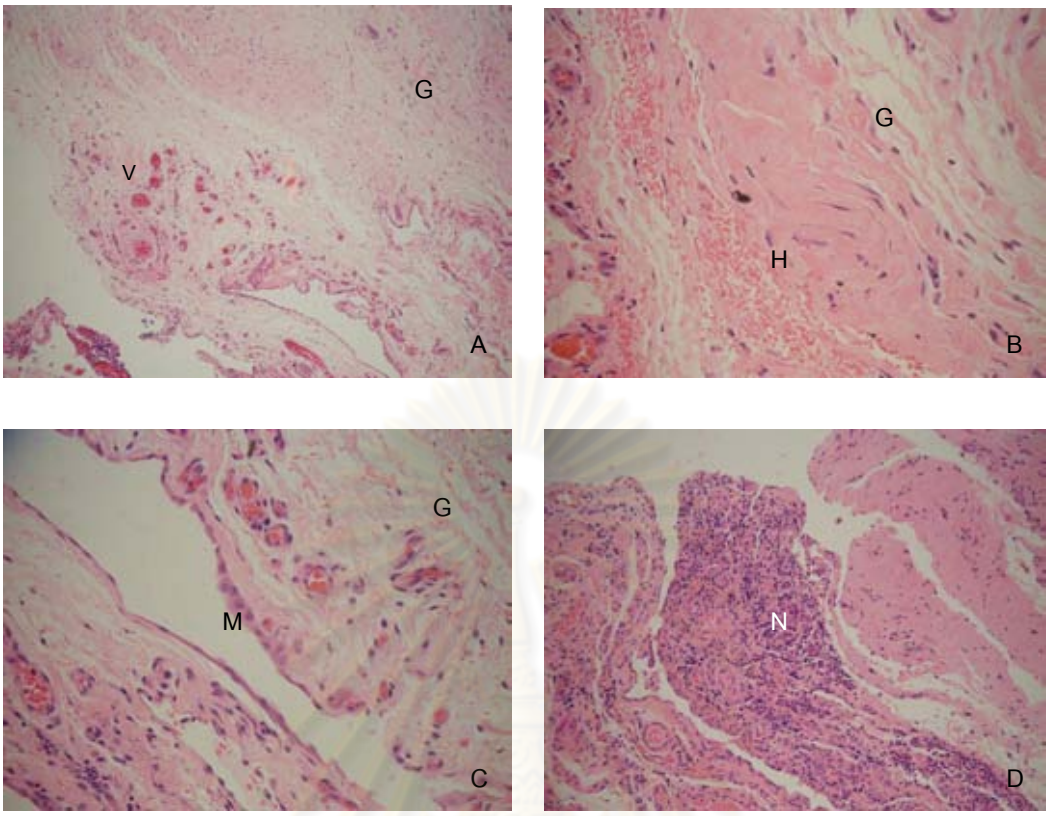


**Figure 15**. The histopathological findings of the graft biopsied from dog 2. A and B. Neovasculalization (V) and hemorrhage (H) in the tunica vaginalis graft (G). C. Regenerated mesothelial cells (M). D. Accumulation of neutrophils (N) throughout the soft tissue adjacent to the tunica vaginalis graft.

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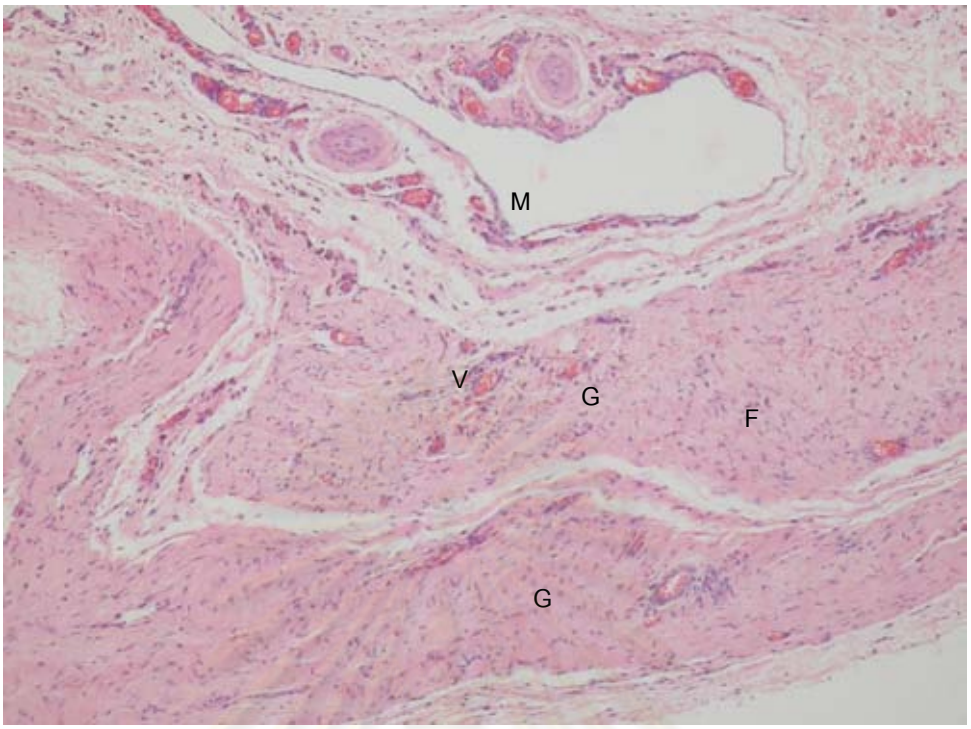


**Figure 16.** The histopathological findings of the graft biopsied from dog 19. Fibrous hypertrophy and collagen synthesis (F), regeneration of mesothelial cells (M), and neovascularization (V) in the tunica vaginalis graft (G)

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# Chapter V

# Conclusion, Discussion, Comment

## Conclusion

This study was designed to use the tunica vaginalis as an autograft for repairing perineal hernia (PH) in 20 intact male dogs which were presented at Surgery Unit of the Small Animal Hospital, Faculty of Veterinary Science, Chulalongkorn University. Fifteen dogs had unilateral PH and 5 had bilateral PH. There were 23 hernias receiving the tunica vaginalis autografting. Before the PH repair, all dogs were castrated and the tunica vaginalis was harvested. The autografting alone was used for repairing 18 hernias whose hernial rings did not extend to ventral of the anus. For 5 hernias with a very large hernial ring or the ring extended to ventral of the anus, transposition of the internal obturator muscle (TIOM) was additionally applied. One dog died 2 and a half months after surgery and was excluded leaving 19 dogs with 22 PH for data analysis. The postoperative follow-up of 8.51 (±3.61) months found reherniation in 2 dogs receiving only the autografting, giving a success rate of 88.23% and a recurrence rate of 11.77%. The success rate of the autografting combined with TIOM was 100% in 5 hernias. The 2 recurred hernias were repaired and the grafts were biopsied for histopathological examination at the second repair. The graft biopsied at 3 weeks after the first repair had neovascularization, regeneration of the mesenchymal cells, and subacute inflammation. The graft retrieved from another dog at 2 months and 3 weeks after the first repair had neovascularization, regeneration of the mesenchymal cells, and synthesis of collagen. Both grafts were viable and no sign of graft rejection was observed. Postoperative complications were wound infection (3/19, 15.8%), wound dehiscence (2/19, 10.5%), and temporary sciatic nerve paresis (2/19, 10.5%). At 3 months after surgery, 18 dogs (94.74%) had normal defecation while 1 dog (5.26%) still had mild defecation difficulty. In conclusion, tunica vaginalis autografting is suitable for repairing the hernia with large hernial ring or weak pelvic diaphragm muscles that is not a candidate of the standard herniorrhaphy or transposition of the internal obturator muscle. The autografting in

conjunction with the transposition of the internal obturator muscle provide a better result of perineal herniorrhaphy.

## Discussion

This study has shown the efficacy of the tunica vaginalis autografting for repairing the perineal hernia with large hernial ring or weak pelvic diaphragm muscles which were not candidates of the standard herniorrhaphy and transposition of the internal obturator muscle (TIOM). Thirty five intact male dogs with PH were presented at the Small Animal Hospital, Faculty of Veterinary Science, Chulalongkorn University during August 2009-June 2010. According to the criteria for inclusion of the cases and the death of 1 dog, 22 hernias in 19 dogs were included in this study and repaired by the autografting with and without TIOM. Mean of the follow-up time was 8.51 months. The success rate of 88.23% and the recurrence rate of 11.77% were found in PH repaired by the autografting alone. When used with TIOM, the success rate was 100%.

The recurrence rates of PH after standard herniorrhaphy have been reported at 10% (Petit, 1962), 15.4% (Bellenger, 1980), 27% (Vnuk et al., 2008), and 46% (Burrows and Harvey, 1973). Recurrence of PH may be due to excessive suture tension at the ventral area of the pelvic diaphragm (Vnuk et al., 2008). TIOM is the alternative technique for a better support of the weak area of the ventral pelvic diaphragm. Recurrence rates after TIOM of 2.4% (Hardie et al., 1983), 5% (Sjollema and Sluijs, 1989), 11% (Vnuk et al., 2008), and 18.75% (Orsher, 1986) have been reported. Comparing with those reports using TIOM, the autografting had higher recurrence rate than TIOM. According to the case inclusion criteria, the hernias of this study were those with large hernial ring or weak pelvic diaphragm muscles which could not be corrected by the standard herniorrhaphy and TIOM. Therefore, our cases might be more complicated than those in the reports using TIOM, resulting in a higher recurrence rate and higher than 8.3% of PH repair using the polypropylene mesh (Clarke, 1989). Importantly, when the autografting was used with TIOM in 5 hernias, no recurrence was found while use of the polypropylene mesh in addition to TIOM found 12.5% recurrence

(Szabo et al., 2007). Therefore, use of TIOM with the tunica vaginalis autografting provide the result better than the use of the autografting alone.

The recurrence of herniation after surgical repair has many contributing factors such as follow-up time, variation of surgeon competency, effect of castration, and repeated herniorrhaphy. During 6-12 months after surgery, the hernia recurred in 8-18% of cases (Burrows and Harvey, 1973; Harvey, 1977; Hosgood, 1995). The increased recurrence rate to 25% was observed with the follow-up lasting more than 1 year (Harvey, 1977) and 50% (Burrows and Harvey, 1973) of cases experienced repeated herniation. The recurrence, when postoperative follow-up time more than 1 year, may be associated with continued deterioration of perineal tissue rather than technical factor (Bellenger and Canfield, 2002). The recurrence was significantly higher when herniorrhaphy was performed by less experience surgeons in some studies (Burrows and Harvey, 1973; Orsher and Johnston, 1985) but not in another (Weaver and Omamegbe, 1981). Recurrence risk of PH in noncastrated dogs is 2-2.7 times greater than in castrated dogs (Hayes et al., 1978; Hosgood et al., 1995). Pooled data from four publications (Bellenger, 1980; Burrows and Harvey, 1973; Harvey, 1977; Hayes et al., 1978) showed that castration reduced the recurrence subsequent to perineal herniorrhaphy from 43% to 23%. However, in the unilateral PH, castration had no effect on the rate of herniation on the contralateral side (Burrows and Harvey, 1973). The higher number of herniorrhaphy may increase risk of the recurrence.

The reherniations in this study were observed in 1 bilateral-PH dog and 1 unilateral-PH dog. In the dog with bilateral PH, the hernia recurred unilaterally on the operated side. Cause of the reherniation may be associated with muscle atrophy or friable pelvic diaphragm muscles secondary to aging and long duration of PH. Pelvic diaphragm atrophy may be due to chronic straining to defecate resulting in stretching of the motor nerves (Harvey, 1977). The hernia extended ventrally to the dilated rectum. It was possible that the muscle was too weak to hold the sutures during straining and stitch bite resulted. The hernia occurred again and colopexy together with cystopexy were additionally performed. In the dog with unilateral PH, the autografting, colopexy, and cystopexy were performed at the first repair. The dog had mild difficult defecation

after surgery. Radiographs showed rectal pouch and caudal displacement of the urinary bladder into the pelvic canal. Both disorders can cause tenesmus, dysuria, or pallakinuria which increase risk of recurrence and rectal prolapse (Gilley et al., 2003). Increased strain may cause caudal displacement of the urinary bladder from the cystopexy site. Benefit of cystopexy is supported by some authors (Hosgood, 1995; Brissot et al., 2004), but not by another (White and Herrtage, 1986). Harvey (1977) suggested that cystopexy is unnecessary in case with bladder retroflexion because of the risk of rupture following anchoring of the urinary bladder. However, PH with bladder retroflexion is a serious problem that requires immediate attention and carries a poor prognosis (Hosgood et al., 1995). Tenesmus remains and recurred PH occurs if the abnormalities of the rectum are not repaired (Vnuk, 2008). Unrepaired rectal abnormalities cause fecal accumulation and straining. Krahwinkel (1983) suggested sacculactomy and rectal plication (inverting suture to rectum) as solution of these problems. However, these techniques was not performed in this study because they may cause postoperative infection and rectal prolapse. Therefore, the dogs' owners in this study were informed to control the diet of their animals. In case of severe rectal dilation or sacculation, colopexy was performed to reduce postoperative tenesmus. Preoperatively, there were 8 dogs with rectal dilation and 5 dogs with rectal sacculation. After surgery, marked improvement of the rectal dilation without signs of difficult defecation or tenesmus was observed in 2 dogs of which 1 received colopexy. Rectal dilation remained in 5 dogs, and slightly improved in 1 dog which received colopexy. However, 5 dogs (included 1 dog with colopexy) did not show signs of difficult defecation or tenesmus. Only 1 dog with remained rectal dilation had mild difficult defecation. This dog was one of the 2 dogs with reherniation (dog 2) which received colopexy later. The difficult defecation was improved but periodically occurred in this dog.

All dogs in this study were castrated to reduce risk of reherniation. There have been many reports (Petit, 1962; Holmes, 1964; Walker, 1965; Hayes et al., 1978; Hosgood et al., 1995) suggesting castration as an important prevention mean of recurred PH while few reports suggest castration only in the case with prostatic

abnormalities (Lawson and Campbell, 1964; Burrows and Harvey, 1973; Harvey, 1977). In the study of Merchav et al. (2005), they compared the expression of canine relaxin, relaxin-like factor (RLF), and relaxin receptors within the muscles of the pelvic diaphragm of dogs with PH and clinically normal dogs. There were significantly higher expression levels of canine relaxin receptors within the pelvic diaphragm and internal obturator muscles. They suggested that relaxin might play a role in the pathogenesis of muscular atrophy which predisposed to PH. Atrophy of these muscles may be associated with the increase of relaxin activity. Relaxin is known as polypeptide hormone which is synthesized in prostate gland and secreted in the seminal plasma in the male. Relaxin may leak from the hypertrophied prostate and caused softening of connective tissue and local muscle atrophy that lead to PH formation (Niebauer et al., 2005). Moreover, benign prostatic hyperplasia is present in almost 100% of sexually intact male dogs over 7 years of age. It may be spontaneously in the gland as early as 2-3 years of age and becomes cystic after 4 years of age. In this study, all dogs were more than 5 years of age and, therefore, had risk of benign prostatic hyperplasia. Moreover, 9 dogs had prostate diseases. The recommended and most effective treatment is castration. The castration can reduce size of prostate gland by 50-70% and alleviate clinical signs within 3 weeks (Parry, 2007). Niebauer et al. (2005) found the strong relaxin immunoreactivity within epithelia of hypertrophic prostates and periprostatic tissues in dogs with PH. The immunoreactivity in normal dogs was less than in PH dogs. In castrated dogs, prostate gland was atrophied and relaxin immunoreactivity was weak or absent. Therefore, castration should be performed in dogs with PH to decrease relaxin production from the hypertrophic prostates and periprostatic tissue, commonly found in dogs with PH, to prevent the recurrence.

Other theories of hormone imbalance associated with PH involved estrogen, androgen, testosterone, and estradiol. Excessive estrogen from aging testis may contribute to relaxation of pelvic diaphragm muscles (Petit, 1962) but the estrogen receptor did not found in these muscles (Mann et al., 1995). Androgen receptors in the pelvic diaphragm muscles were detected significantly higher in the castrated dog without PH. The numbers of androgen receptors in dogs with PH were less than both the

castrated and the non-castrated normal dogs. The lack of androgen receptors within the pelvic diaphragm muscles may be conduced to etiopathogenesis of PH in dogs (Mann et al., 1995). Serum testosterone level was not significantly different between the noncastrated dogs with PH and the noncastrated dogs without PH of the same age, while the serum testosterone level in the castrated dogs with PH was significantly less than that in the noncastrated dogs with PH and in the noncastrated dogs without PH (Mann et al., 1989). Therefore, they suggested that castration should not be done unless the castration-responsive contributing factors or prostatomegaly was identified.

The concurrent diseases in this study were mainly involved the prostate (9 dogs). They were prostatomegaly, prostatic cyst, and prostatic abscesses which responded to castration. The prostate glands were gradually reduced in size after castration. In case of prostatic abscess, continued antibiotic administration is required for 1 month. Tenesmus caused by an enlarged prostate can apply traction to nerves of the sacral plexus. The damaged nerve can cause neurogenic muscular atrophy in association with the development of PH (Sjollema et al., 1993).

Concurrent tumors were perineal fat-originated in 1 and testicle-originated in 2 dogs. Histopathologically, perineal tumor was liposarcoma of mesenchymal or connective tissue cell in origin. It often occurs in old dogs and arises from the skin or subcutis. Most report it is unlikely metastatic, but few suggest it is aggressive, locally invasive, and commonly metastatic to lung, liver, and bone (Liptak and Forrest, 2007). The dog was called back to be examined and found no matastasis and recurrence. Histopathological examination of the testicular tumors from the 2 dogs revealed seminoma in 1 and intratubular seminoma in the other dogs. Testicular neoplasia occasionally occurs with PH. Most types which frequently occur are seminoma and interstitial cell tumors with 19% and 15% of tumor cases, respectively (Bellenger and Canfield, 2002). They are rarely metastatic (Hedlund, 2007).

There have been many reports of high PH incidence in certain breeds. They are Boston terrier (Burrows and Harvey, 1973), Boxer (Bellenger, 1980; Burrow and Harvey, 1973), Collie (Burrows and Harvey, 1973; Weaver and Omamegbe, 1981), Corgi (Bellenger, 1980; Burrows and Harvey, 1973; Weaver and Omamegbe, 1981), Old

English sheep dog (Weaver and Omamegbe, 1981), Pekingese (Weaver and Omamegbe, 1981), toy Poodle (Hosgood et al., 1995), and Yorkshire Terrier (Raffan, 1993). Most dogs with PH enrolled in this study were mixed-breed dogs (8), Shih tzu (5), and Poodle (4) which were popular breeds in Thailand. Seven dogs (33.33%) had docked tails. Their levator ani and coccygeal muscles may be underdeveloped as in the short tailed dog because of lack of tail movement of the muscles (Bellenger and Canfield, 2002). The mean age of dogs in this study was 9 years (range, 5-12 years), similar to another study which found PH most common in dogs with 7-9 years of age (Weaver and Omamegbe, 1981). Risk of PH was increased with age from 7 to 9 years in Boxer, Boston terrier, and Pekingese and from 10 to 14 years in Collie and mongrel dogs (Hayes et al., 1978).

Clinical signs included perineal swelling, depression, anorexia, vomiting, abdominal clamp, urination problems, and defecation problems. Most owners concerned urination and defecation problems more than perineal swelling. Ninety-five percent of the cases had these problems as chief complaints. All cases with urination problems were associated with bladder retroflexion. However, not all cases with bladder retroflexion showed the urinary sign. Azotemia, the accumulation of BUN or other nitrogenous substances such as creatinine, was found in 3 dogs with UB retroflexion and 2 dogs without the retroflexion. UB retroflexion can cause postrenal azotemia due to urinary obstruction (Burrows and Harvey, 1973). In addition, BUN may be increased by endogenous protein catabolism including fever, starvation, prolong exercise, recent glucocorticoid administration, burn, and sepsis, or other factors such as dehydration and decreased cardiac output. Elevated serum creatinine may be associated with renal or postrenal disorders. The majority of creatinine is produced from skeletal muscle breakdown of creatine which is converted to creatinine each day. The amount of creatinine formed daily depends on dietary intake, rate of synthesis, and total skeletal mass. A muscular dog is expected to have a higher serum creatinine than less muscular one (Squires, 2005).

Leukocytosis is vital host defence for initiation and control of inflammation and immunity. Lymphoid cells are required for adaptive and acquired immune response

which activated by inflammation induced by any pathogens (Blackwood, 2005). Therefore, leukocytosis in PH cases may be induced by any inflammatory insults, for example, prostatitis, cystitis, or inflammation of the perineal area.

Of 15 unilateral PH, 10 (66.67%) were on the right and 5 (33.33%) were on the left. Similar to the data reviewed by Bellenger and Canfield (2002), 213 of 321 dogs with unilateral hernia (66%) were on the right and 108 (34%) were on the left. There is no proof of an intrinsic muscle weakness on the right side of pelvic diaphragm even though individual muscles vary in weight between the right and left sides that is sometime significantly different. PH may be related to the rate and extent of deterioration of the tissue on the affected side of the pelvic diaphragm. However, the contralateral side of the unilateral hernia is usually weak (Burrows and Harvey, 1973).

Complications found in this study were wound infection (15%), wound dehiscence (10%), and sciatic nerve paralysis (10%). Wound infection and wound dehiscence were the most two common complications of PH repair. The incidence of wound infection or breakdown has been reported as 6% (Orsher, 1986), 13% (Weaver and Omamegbe, 1981), 20% (Bellenger, 1980), and 26% (Burrows and Harvey, 1973). The bacterial culture from 1 of the 2 dogs with wound infection in this study found $\beta$-haemolytic *Streptococcus* spp. and *Klebsiella* spp. which were susceptible to amikacin, amoxicillin/clavulanic acid, and cephazolin. Non-haemolytic *Streptococcus* spp. and *Pseudomonas aeruginosa* were found in the bacterial culture from the other dog and were susceptible to amikacin and enrofloxacin. In another study, the most common organism was *Escherichia coli* and occationally isolated *Proteus*, *Staphylococcus*, *Klebsiella*, and *Bacteroides* species. Infection rate can be reduced by less traumatic surgical technique and reduction of fecal contamination. However, wound infection and dehiscence in this study did not cause graft failure. Lameness on the same side of surgery occurring in 2 dogs might be a result of trauma at the sciatic nerve that may occur when sutures are placed craniolaterally around the sacrotuberous ligament. The nerve may be penetrated or entrapped and temporary or permanent lameness may be resulted (Burrows and Harvey, 1973). Removal of the sutures should be performed immediately. Recovery may take several weeks to months and may not be completed.

Complete recovery may take 2 to 4 weeks (Bellenger and Canfield, 2002). Sciatic neuroplaxia may be resulted from positioning the patient in sternal recumbency with their legs tied firmly forward. In this study, the lameness resolved after removal of the sutures entrapping the nerve in 1 dog while no surgical correction was done in the other dog according to the owner's request.

The 2 recurred hernias were repaired and the grafts were biopsied. Both grafts were viable and no sign of graft rejection was observed supporting its use in herniorrhaphy. Histopathological examination of the graft biopsied at 3 weeks after the first repair revealed neovascularization, regeneration of the mesenchymal cells, and subacute inflammation. Another graft biopsied at 2 months and 3 weeks after the first repair histopathologically had neovascularization, regeneration of the mesenchymal cells, and synthesis of collagen. Similar to finding of Abass (2008) using bovine tunica vaginalis for repairing the experimentally-created umbilical hernias in 8 sheep. Histopathological examination revealed dense fibrous connective tissues, heavy bundles of collagen fibers, newly formed capillaries, and momonuclear inflammatory cells deposition throughout the graft. Another study used processed bovine tunica vaginalis for implantation in a rat model (Hafeez et al., 2005) and scanning electron microscope for microscopic evaluation. There were excessive infiltration of inflammatory cells at 1 weeks and less structural change at 3 weeks after implantation. At 18 weeks after implantation, no calcification and foreign body giant cell formation were observed and the implants were replaced by fibrous tissue. According to these two reports and our finding, tunica vaginalis can be used as an autograft or the xenograft for herniorrhaphy.

**Comment**

Tunica vaginalis autografting is effective for repairing the perineal hernia with large hernial ring or weak pelvic diaphragm that is not a candidate of the standard herniorrhaphy or transposition of the internal obturator muscle. Use of this technique in combination with transposition of the internal obturator muscle provides a better result of perineal herniorrhaphy.

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