Journal of Animal and Veterinary Advances 8 (9): 1802-1806, 2009
ISSN: 1680-5593

Formation of a New Urethral Channel in Male Dogs Using Jejunal Segment: An Experimental Study

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Abstract: The aim of this study was to determine the usability of a jejunal flap in male dogs to treat cases of serious urethral damage caused by tumor, trauma or innate anomalies that occur in the urethra. Seven adult dogs were used in the study. Following xylazine-ketamine-isoflurane anesthesia, using median laparotomy, we penetrated the abdominal cavity. A 10-15 cm long intestinal segment was formed by enterectomy. One end of this intestinal segment was attached to the prostatic urethra with stitches. The other end was inserted through a hole formed by prepicium mucosa and was fixed to that area. Subsequent observation over a period of 4 months showed that the animals were able to urinate without discomfort and no stoma and stenosis developed in anastomosis area. Histopathologic examinations indicated that urethral jejenum perfectly adapted to the area and the structure of intestinal mucosa changed in time. As a result of the study, it was concluded that jejunal flap is suitable for urethral reconstruction.

Key words: Urethra, jejunal flap, dog, experimental study, synthetic materials, abdominal cavity

INTRODUCTION

Urethra reconstruction is required due to injury (traumas such as traffic accidents, injuries caused by firearms, bite scars and iatronic injuries) os penis and pelvis fractures, infections, urethral stones, iatrogenic damage, urethral tumors or innate defects such as hypospadiasis (Atalan *et al*., 2005; Bales *et al*., 2002; Fossum *et al*., 1997; Koshima *et al*., 1999). For urethral narrowness, urethroplasty techniques involving difficult surgical invasive techniques are often used (Nisbet and Ozak, 2005; Fossum *et al*., 1997). Many synthetic products are available, such as silicon, Teflon, Dacron, Gore-Tex, vitalium, polyvinyl chloride and collagen tubes (Baltaci *et al*., 1998; Fossum *et al*., 1997; Verit *et al*., 2003), in addition to methods utilizing prepicium skin, bladder, intestinal flaps or autologous grafts obtained from free flaps of fascia lata or mouth mucosa (Abol-Enein *et al*., 1993; Atalan *et al*., 2005; Gunay *et al*., 2003; McAninch and Morey, 1998; Mitchell, 1986; Ozdemir *et al*., 1997; Waldner *et al*., 1999; Xu *et al*., 2002). However, they have limited use due to high infection risk of synthetic materials, biologic incompatibility, crystal concentration, graft migration and structure formation. For this reason, autogenous grafts are preferred in these kinds of cases (Ozdemir *et al*., 1997; Mitchell, 1986; Sade *et al*., 2007).

The aim of this study was to determine the applicability of pedicle jejunal flaps for reconstruction of experimentally-formed urethral defects in dogs, based on clinical, positive contrast urethrography, macroscopic and histopathologic assessments.

MATERIALS AND METHODS

The study used 7 adult dogs, whose weight ranged between 20-24 kg. The experimental study was carried out in accordance with ethical considerations. Clinical examination indicated that all the animals were healthy.

Anesthesia protocol: The animals were not fed during the 12 h prior to the operation. The animals were administered 2 mg kg^{-1} intramuscular (im) xyzaline hydrochloride (Bayer-Rompun 23.22 mg mL^{-1}), followed 10 min by 15 mg kg^{-1} im ketamine hydrochloride (Alke-Ketanes 100 mg mL^{-1}). Endotracheal intubation was applied and anesthesia continued with 2% isoflurane.

Chirurgical procedure: The animal was laid on the operation table in a supine position. The ventral abdominal wall between cartilage xiphoid and os pubis was shaved and disinfected. The area was surrounded by sterile wipes. A 14-16 h urethral catheter (*Foley catheter*) was placed in the urethra for the dissection of penile

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tissue and in order to facilitate anastomosis of the jejunal segment to the urethra. A 8-10 cm long paramedian incision was made in the lateral of the preputium and just in front of the os pubis. After penetrating the abdominal cavity, vesica urinaria was pulled aside, a forceps was placed on the collum vesica and then the urethra was dissected in the distal of the prostate (Fig. 1).

The jejunal segment to be used to form the urethral channel was removed from the abdominal cavity and placed on a sterile wipe. After placing a two-sided intestinal forceps, the mesenteral veins remained untouched and an enterectomy was performed. This intestinal segment was pulled aside and the two ends of the intestine were put together and anastomosis was performed using 4/0 vycryl and was placed in the abdominal cavity. The lumen of the jejunal segment was first washed with antiseptic water, than with physiological serum. The proximal end of the jejunal segment was put together with the prostatic urethra and anastomosis was performed using 4/0 vycryl.

Under the guidance of a channeled drain, which penetrated from the preputium, an incision was made from an area close to the preputium hole to the abdominal cavity using a number 15 bisturi. The jejunal segment was anastomosed to the prosthetic urethra. The jejunal segment was attached to this incision line opened in the prepicium channel with 4-0 vicryl in such a way to pass through the seromuscular layer (Fig. 1). The muscles were closed using number 0 chromic catgut. The skin was closed with number 1 silk suture in simple separate stitches.

Postoperative care: In order to allow urine drainage and to assist the healing process of the anastomosed area, a Foley catheter remained for 7 days. In order to prevent, the dog removing the catheter, a protective collar was placed around the neck. The catheter was irrigated with povidone iodine solution each day. The animals were given 1000 mg cefazolin (Cefamezin 1000 g, Eczacibasi Ilac San. and Tic. A.S. Istanbul) im for 7 days. As a pain killer, 2 g im metamizol sodyum (Novalgin 2 mL 10 ampul, Aventis Pharma Sanayi and Tic. Ltd. Sti.) was used for 5 days.

Positive contrast urethrography: At 30, 60 and 90 days postoperatively, the animals were sedated with xyzaline hydrochloride (2 mg kg^{-1} iv). Twenty milliliter (Urografin 76%, Schering AG, Germany) was injected into the jejunal urethra as retrograft and positive contrast urethrographies were taken.

Macroscopic and histopathologic examination: After 4 months, the animals were euthanized via a high dose of anesthetic. Macroscopic and histopathologic findings were then analyzed. For the analysis of histopathologic findings, tissue samples were analyzed in 10% formaldehyde solution. Samples were then embedded in paraffin blocks, using the traditional histological process. Using a microtome, the blocks were sectioned at a thickness of five microns and stained with hematoxylin-eosin, Masson's trichrome and Van Gieson methods. The samples were then analyzed using a light microscope.

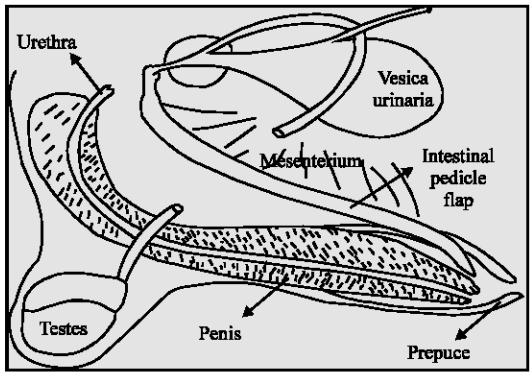

Fig. 1: Schematic representation of the urethro-jejunal transplantation technique

RESULTS

Clinical analysis indicated that 3 dogs experienced dysuria during the first 3 postoperative days. After day 7, when, the urinal catheter was removed, it was observed that all of the dogs had normal urinary flow and had no involuntary urination. Since there was no urinary leakage, apart from normal urination, the prepicium was constantly dry. This continued until the end of the 4th month, when the dogs were euthanized. The chirurgical wound area and the the anastomotic area at the end of the prepicium completely healed.

During positive contrast urethrography, a larger intestinal lumen and prostatic urethra and bladder, in which anastomosis was applied were clearly detected. In contrast urethrographies no fistula or stricture was observed in the dogs (Fig. 2).

In order to conduct macroscobic analysis, after euthanasia procedure, an incision was made from one side of the penis and the abdominal cavity was penetrated. It was observed that there was a good union in the area where the jejunal segment was attached to urethra (Fig. 3). No ulcer, fistula or structure was observed along the channel in the anastomosed area. However, in 2 dogs a moderate level of adhesion was observed and a lower degree of adhesion was observed in the other 5 dogs.

In histopathologic terms, it was found that almost all of villi intestinals were atrophied. Single fold prismatic

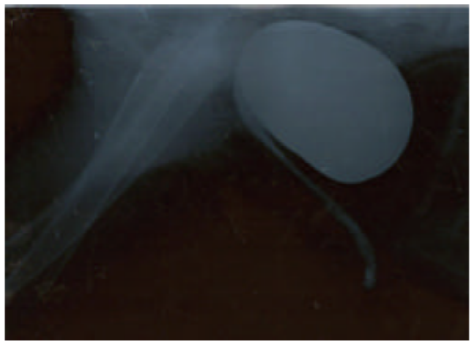

Fig. 2: The radiographic appearence of urethral jejunal segment and vesica urinaria (4th month)

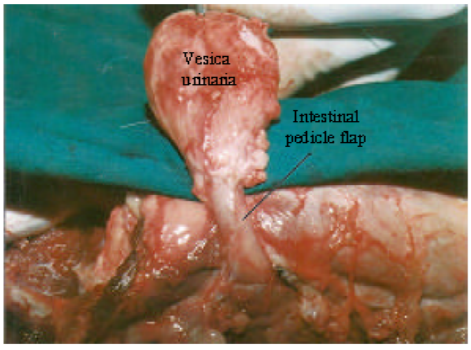

Fig. 3: The macroscopic appearence of urethral jejunal segment and vesica urinaria

Fig. 4: The microscopic appearance of urethral jejunal segment (atrophy at villus intestinalis and glandula intestinalis degeneration and necrosis in epithelial cells)

epithelial cells of lamina epitelialis were subject to metaplasis and took the form of thick and thin layers. It was found that glandula intestinalis within the lamina propria were atrophied. Degeneration and necrosis was formed in epithelial cells. In addition, thickening was observed in some parts of the sub mucosa due to inflammatory cell infiltrations (Fig. 4).

DISCUSSION

Various techniques have been developed for urethral reconstruction. In addition, various autograft and synthetic materials are used for urethral reconstruction. However, both in experimental studies and in practice, these materials are often used for the reconstruction of a partial defect. In this study, a pedicle jejunal autograft was used with the purpose of producing a new urethral channel in cases of total loss of the urethra.

Baltaci *et al.* (1998) and Verit *et al.* (2003) reported that since, there is no peristaltic movement in the urethra, synthetic materials can be used in urethral reconstruction. Verit *et al.* (2003) reported that synthetic grafts allowed for new endothelial development in the urethral channel and that they can be an appropriate material for urethral reconstruction. On the other hand, Atalan *et al.* (2005) and Baltaci *et al.* (1998) reported that synthetic materials generally resulted in negative outcomes. The reasons for failure of synthetic materials include, infection, narrowing developing within the anastomosis area due to wound tissue, fistula and decrease in epithelial tissue formation, bio-incompatibility and graft migration. It was found that the jejunal autograft used in the operation had no compatibility problem and no significant complication occurred except a slight adhesion. Due to the complications that occur as a result of synthetic material use, it has been necessary to use autogenous grafts. However, Atalan *et al.* (2005) reported that in studies carried out with autogenous grafts, occasional complications arose, such as narrowing in channels, fistula stone formation and contracture of the grafts. The potential for these complications has encouraged researchers to find alternative materials.

Sade *et al.* (2007) reported that due to their availability and abundance, skin grafts are appropriate materials for urethral reconstruction. However, in skin and mucosal grafts, the area from where the graft is collected should have a proper vein network. Khazanchi *et al.* (1998), Koshima *et al.* (1999), Ozdemir *et al.* (1997) and Waldner *et al.* (1998) reported that some important complications such as lack of epithelium formation, stenosis, diverticula, stone and hair formation may be observed due to the use of skin grafts. In the method used in the present study, the fact that the pedicle jejunal segment was flexible and can be extended was an advantage. Another advantage of using a jejunal flap is that it keeps its vitality in the application area. In addition, none of the complications observed in use of skins was observed in the present study.

Mouth mucosa is a popular material used for urethral reconstruction. The biggest advantage of buccal mucosa

when, compared to skin is that buccal mucosa is widely available. Buccal mucosa has a thick epithelium and a thin layer of lamina propria and provides the possibility of revascularization in the graft area (Koshima *et al*., 1999). Although, an abundant amount of elastin in epithelium allow it to be flexible and easily formed by hand, this increases constriction and structure risk. In addition, the amount of graft to be collected is limited and pain and infection can be observed in the area where the graft is collected. In the present study, since, the jejunal graft was fed by mesenteric veins, it had a better feed when compared to buccal mucosa and skin. In addition, the amount of jejunal graft is not limited as buccal mucosa. A jejunal graft can be removed in any desired size and no significant complication was observed in the area where, the graft was collected.

Colonic mucosa is a common graft material used for urethral reconstruction. However, the area from where graft is removed should have a good vein network for the success of this method (Lebret *et al*., 1995; Pope and Khoc, 1996). Xu *et al*. (2003) reported that glandular epithelium in colonic mucosa, which they used for urethral reconstruction in 18 rats turned to urothelium in 3-6 months postoperatively. The epithelial transformation, which occurred after using colonic mucosa was also detected in the present study. However, desquamation, which occurred in colonic mucosal grafts was not observed in our study.

Bales *et al*. (2002) reported that they applied free jejunal tissue transfer in 2 patients with complex urethral narrowing. Following the operation, the patients had a proper urine flow. The researchers indicated that the very long period required to apply this technique, necessitated a good microvascular anastomosis and laparostomy for the collection of the jejuna segment from the patient. The disadvantage of this technique was the long period of anesthesia required for this procedure. In addition, the researchers indicated that following this operation, complications such as sacculation, urine instillation, infection and stone formation may be observed in the patients. Abol-Enein *et al*. (1993), Ozdemir *et al*. (1997), Roth *et al*. (1996) and Waldner *et al*. (1998) reported that in intestinal flap techniques, due to the absorption and secretion properties of the intestine, some undesired outcomes such as the absorption of electrolytes and nitrogen wastes can be observed.

In the present study, the technique introduced by Bales *et al*. (2002) were modified and applied to dogs. When compared to other autograft material, jejunum has some advantages. Jejunum is widely available, it can be prepared in any size and has a flexible structure. For this reason, especially in serious losses of urethra, jejunum can be used with confidence.

The disadvantages of this method include the need for laparotomy for the collection of jejunum, postoperative intraabdominal adhesion formation and infection risk due to the fact that jejunum is colonized by normal bacterial flora. However, in the present study, a *Foley catheter* was left for 7 days with the purpose of minimizing infection risk and the urethral catheter and jejuna segment were disinfected by washing with povidone-iodine solution. In contrast urethrographies, no narrowing was detected in the channel and it was observed that at seventh day after the removal of the catheter, the dogs had voluntary urination with no discomfort, which was the desired result. In histopathologic analyses, it was found that intestine villi were atrophied. It was thought that this was an indication of loss of absorption and secretion properties of the intestinal segment in time.

CONCLUSION

Consequently, we believe that jejunal flap is an appropriate material for urethral reconstruction in the treatment of large defects in urethra and urethral tumors.

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