Reconstruction Of The Ureter With An Autogenous External Jugular Vein Graft In A Bitch Model

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ABSTRACT

Seven apparently healthy mongrel bitches were used in the present study to assess the suitability of the autogenous external jugular graft for ureteral reconstruction. A 2-cm left ureteral segment was resected and replaced with a 2-cm segment of external jugular vein graft by end-to-end anastomosis in a simple interrupted suture pattern using 6-0 prolene. Results showed that all bitches appeared clinically normal throughout the period of the study. Twelve weeks postoperatively, the left ureter appeared unstained at the X- Ray film using urographine as a contrast media in all cases. Abdominal ultrasonography showed enlargement of the left kidney and dilation of the anechoic renal pelvis at 6 &12 weeks postoperatively. Macroscopically, there was an intense fibrous reaction at the site of the graft with adhesions to the surrounding structures. Microscopically, the submucosa of the graft showed transformation into cartilage (cartilaginous metaplasia). The kidney had multiple cystic dilatations of the renal tubules. In conclusion, the autogenous external jugular graft seems to be unsuitable for ureteral reconstruction in bitches.

INTRODUCTION

The ureter is an important part of the urinary system that can be affected by several disorders such as congenital malformations, extensive iatrogenic ureteral obstruction, ureteritis, retroperitoneal fibrosis, trauma, necrosis, calculi and tumors. For these reasons, ureteral reconstruction is indicated for ureteral strictures secondary to retro-peritoneal fibrosis, surgical trauma, ureteral obstruction due to abscess and ureteritis, iaterogenically induced ureteral injury, recurrent uretero-pelvic junction obstruction, intractable stone disease and ureteral carcinoma *(1,2)*.

The problem of ureteral reconstruction has not been fully solved, despite dramatic developments in surgical methods. Many attempts to repair a ureteral damage with autologous or homologous organ grafts or with organic substitutes have not really been satisfactory *(1)*. Various organic substitutes and synthetic prostheses were used in the reconstruction of ureteral continuity. Ureteral reconstruction is made using a segment of the saphenous vein *(3,4)* alloplastic materials, such as cobalt-chromium, polyvinyl chloride, polyethylene, polytetrafluoethylene, silver, silicon rubber, polyester, collagen and polyglactin *(5,6)*, and ovine fetal urachus duct *(2)*.

Thus, the aim of this study was to assess the suitability of the autologous external jugular graft for ureteral reconstruction and to analyze the histomorphologic changes in the urinary tract of bitches after this reconstruction.

MATERIALS AND METHODS

Seven apparently healthy mongrel bitches with ages ranged from 1to 2 years old and their weights ranged from 12 to15 kg. were used in this study at the Department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine, Suez Canal University.

Food was withheld twelve hours before the operation. About 10-15 minutes perior to the induction of general anesthesia, each bitch was premedicated with intramuscular injection of chloropromazine hydrochloride (Neurazine: Misr Co. Pharm. Industries, S.A.A. El-Mataria, Cairo, Egypt) in a dose rate of 1 mg / kg. B.W. *(7)*. Aseptic preparation for the sites of the operation had been done. General anesthesia was then conducted by intravenous injection of thiopental sodium 2.5 % (Thiopenal Sod.: Egyptian international pharm. Industries Co. A.R.E.) until the main reflexes were abolished. The animals were draped with sterile towel except the sites of operation. Balanced electrolyte (Sodium chloride

0.9%) solution in a dose 10 ml/kg/hr was administered during surgery.

Animals were placed in the lateral position and a longitudinal neck incision was made just medial to sternomastoid muscle. The external jugular vein was identified and dissected (Fig. 1). A two cm segment of jugular vein was chosen to have no or very few tributaries and harvested after secure ligature at the proximal and distal ends of the vein using silk 3/0. The segment is immediately immersed into 0.9 % saline and stinted using number 6 Fr feeding tube (Fig. 2).

A lower ventral midline incision measuring approximately 20 cm, craniad the pubic symphysis was used in all cases for exposure and exteriorize of the left ureter. Two holding sutures of 0 chromic catgut were placed on the ureter. A 2-cm ureteral segment was resected between these two holding sutures. The autologous external jugular vein graft and the two ends of the ureter were intubated with a 6 Fr feeding tube. The continuity of the ureter was restored with the external jugular vein graft using end-to-end anastomosis in one layer closure with simple interrupted suture pattern using 6-0 prolene by aid of 4X binocular loops (Figs. 3&4). The laparotomy incision was closed using polyglactin 910 No. 0 (Vicryl: Manufactured Johnson & Johnson Jutl) in a simple continuous pattern for peritoneum and linea alba. Skin edges were sutured using silk No. 0 in a simple interrupted pattern.

Each animal was injected with 10 mg/kg of cephalexine (Ceporex: Cephalexine Glaxo Wellcome Egypt S.A.E.) I.V. once daily for five days and dipyrone (Analgin: Dipyrone 50% United Co. for Chem. & Med. Prepn. (UCCMA)) in a dose of 10 mg/kg I.M. for 3 days. After recovery, bitches were allowed for water free choice, continued to receive intravenous fluids for 48 hours after surgery, and were gradually returned to full feed over the next 48 hours. Each bitch was observed till the end of the experiment.

Assessments of the reconstructed ureter by

A- Clinical findings

Bitches were monitoring for appetite, urine output, urine abnormalities, abdominal distention, abdominal pain and body temperature.

B-Intravenous pyelography (IVP) and abdominal ultrasonography

Intravenous pyelography (IVP) was performed using urographine as contrast medium that injected via cephalic vein. Lateral and ventrodorsal radiographs of the abdomen were taken at 6 and 12 weeks postoperatively. Abdominal ultrasonography was performed at 6 and 12 weeks postoperatively, using a real time scanner with an 7.5 MHz broadband, convex, phased array transducer.

C-Pathological examination

Bitches were euthanized by over dose intravenous injection of thiopental sodium at 12 weeks postoperatively for histopathological study. The specimens from both kidneys and ureters were fixed in 10% neutral buffered formaline and routine procedures for tissue processing and sectioning were performed. Tissue sections were then stained with hematoxylin and eosine (H&E) *(8)*.

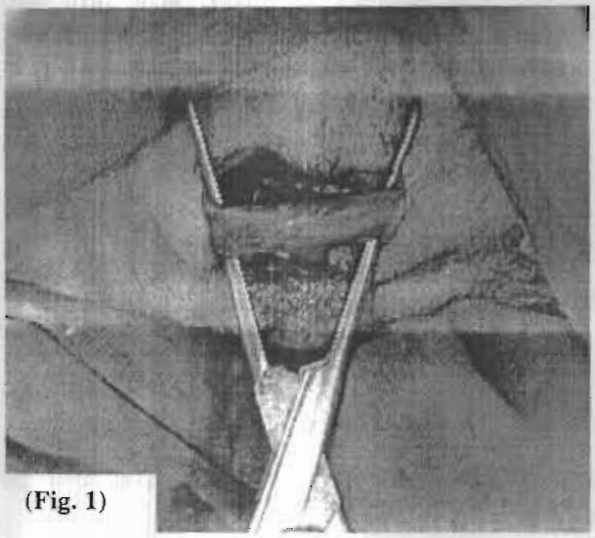
RESULTS

All bitches appeared clinically normal depending on their good appetite, normal defecation, normal urine output and there were no abdominal distention for 12 weeks postoperatively.

Intravenous pyelography (IVP) at 6 weeks postoperatively, showed hydronephrosis of the left kidney. At 12 weeks postoperatively, the left ureters in all animals were unstained after intravenous injection of urographine, as a positive contrast media, while the right side showed passage of the contrast media through ureter and urinary bladder (Fig. 5). Abdominal ultrasonography showed enlargement of the left kidney and moderate dilation of the anechoic renal pelvis that it is measured 0.6 by 2.1 cm width at 6 weeks postoperatively (Fig. 6). Dilation of the renal pelvis is ultrasonographically characterized by separation of the normal, uniformly hyperechoic, and central renal sinus echoes causing an anechoic space. At 12 weeks postoperatively, the left kidney appeared more enlarged that it is measured 1.8 by 3 cm width (Fig. 7). A variable area of renal cortex and diverticula were visible about periphery of the kidney dependant on the degree of

hydronephrosis. Anechoic areas with well-defined near and farwalls and through transmission. At 12 weeks postoperatively, the left kidney was 3.4 by 5.2 cm in diameter and showed hypoechoic (Fig. 8).

Macroscopically, all left kidneys were markedly hydronephrotic with dilated pelvises (Fig. 9). There was an intense fibrous reaction at the site of the graft with adhesions to the surrounding structures. After opening the ureters, there was complete obstruction of the lumen at the site of the graft. Microscopically, the ureter appears normal before the graft and display normal transitional epithelium. After the graft, the ureterine epithelium showed hyperplasia of the transitional epithelium and mucinous degeneration. The submucosa of the graft showed transformation into cartilage (cartilaginous metaplasia) (Figs. 10&11). The kidney had multiple cystic dilatations of the renal tubules as well as atrophy in the parenchyma due to hydronephrosis (Fig. 12).


(Fig. 1)

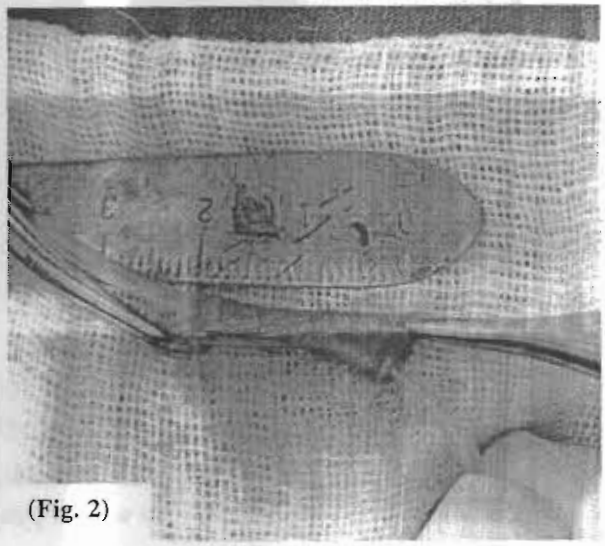
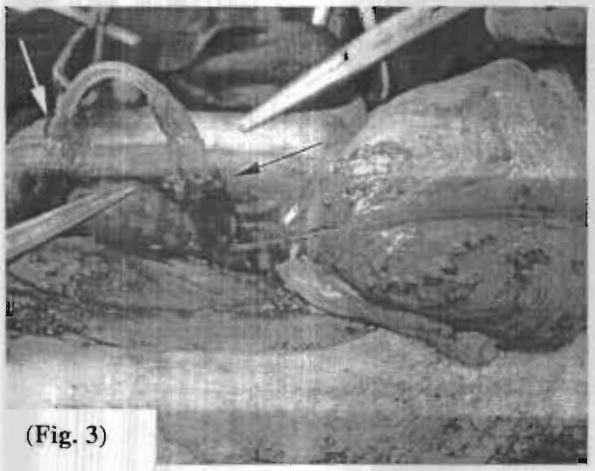

(Fig. 2)

Fig. 1. Dissection of the external jugular vein.
Fig. 2. Specimen was taken from the external jugular vein (about 2 cm).


(Fig. 3)

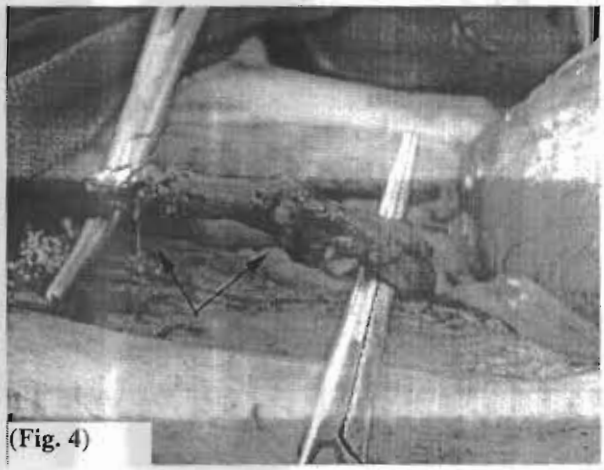

(Fig. 4)

Fig. 3. End-to-end anastomosis between external jugular vein graft and distal ureter in simple interrupted suture pattern using 6-0 prolene (black arrow) and feeding tube (white arrow) was passed through proximal ureter, jugular graft and distal ureter in a bitch.
Fig. 4. The lines of anastomosis between the external jugular vein graft and ureter in a bitch (black arrows).

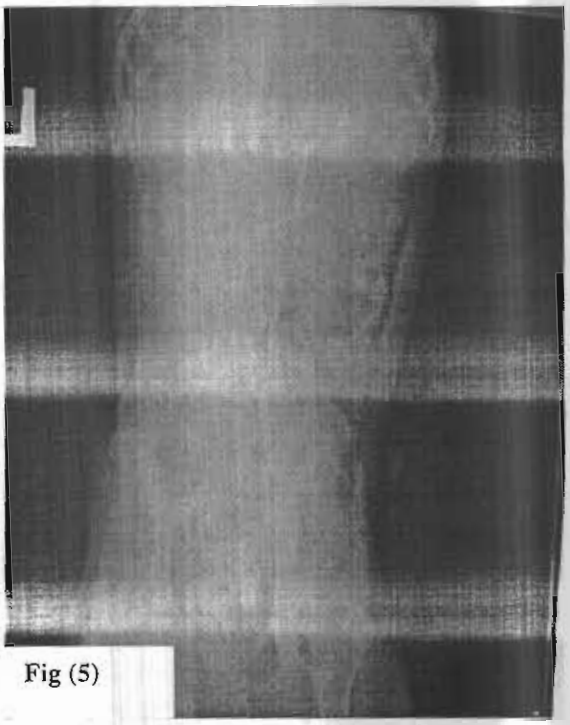
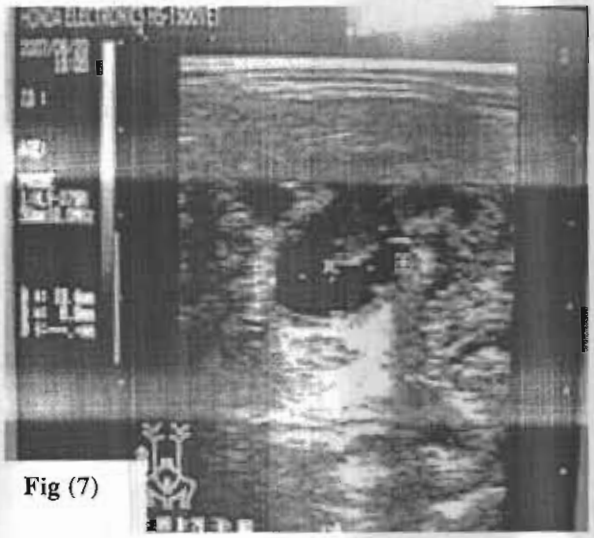


Fig (5)

Fig (6)

Fig. 5. Ventrodorsal view of intravenous pyelography (IVP) at 12 weeks postoperatively showing passage of contrast medium through right ureter and urinary bladder in a bitch.

Fig. 6. Ultrasonograph of the left kidney showing moderate dilation of the anechoic renal pelvis measuring 0.6 by 2.1 cm at 6 weeks postoperatively a bitch.



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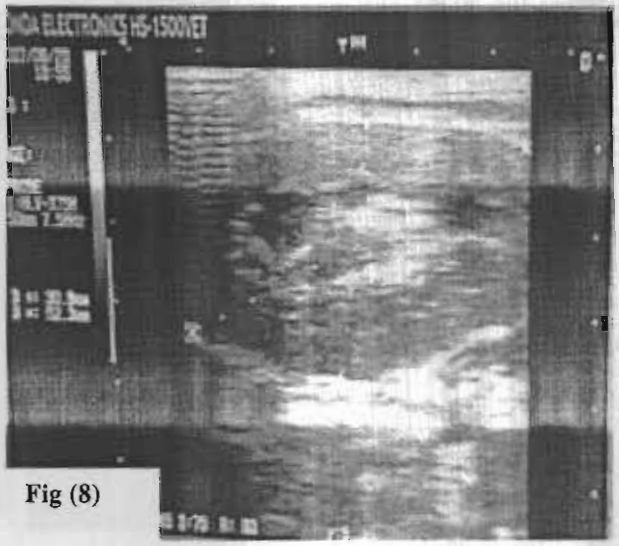
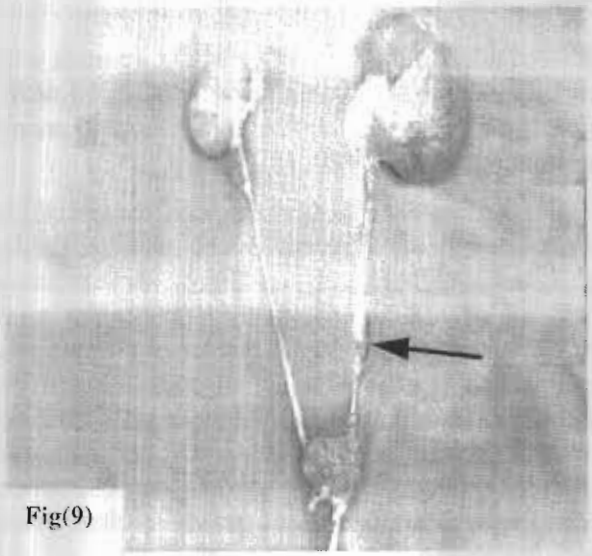


Fig (8)

Fig. 7. Ultrasonograph of the left kidney showing more dilation of the anechoic renal pelvis measuring 0.6 by 2.1 cm and anechoic ureter measuring at 12 weeks postoperatively a bitch.

Fig. 8. Ultrasonograph of the left kidney was 3.4 by 5.2 cm in diameter as hydronephrotic kidney a bitch.



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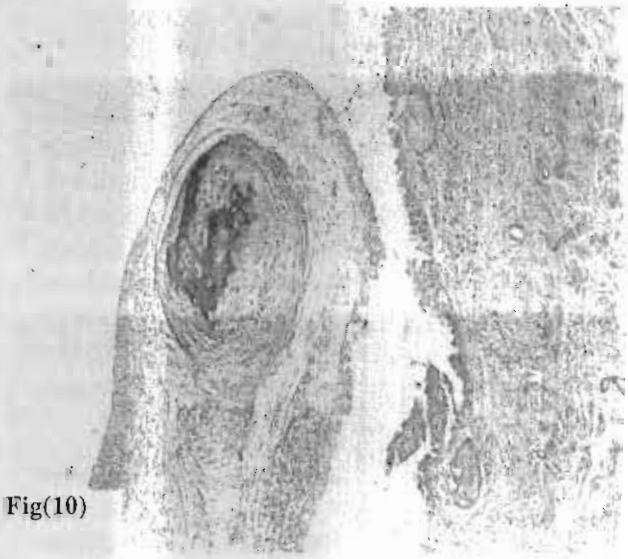
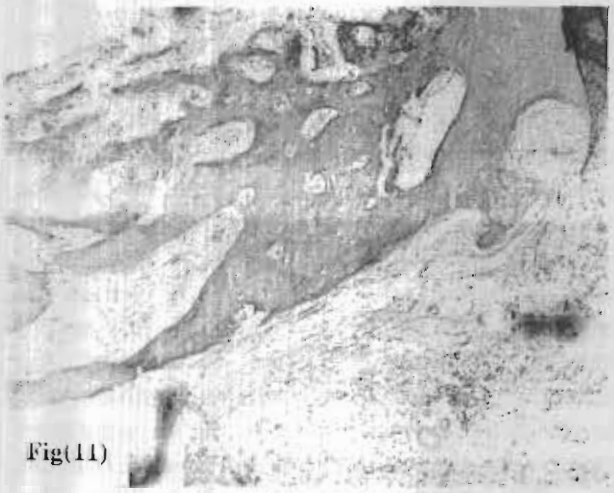


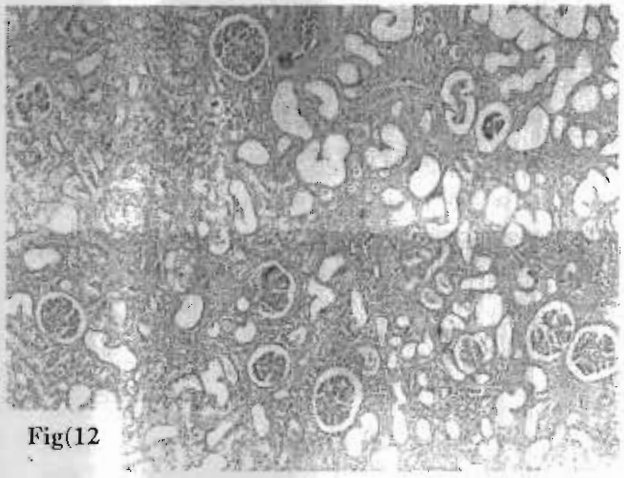
Fig(10)

Fig. 9. Grossly showing hydronephrotic left kidney with dilated renal pelvic (white arrow) and obstruction at the seat of the graft (black arrow), 12 weeks postoperatively a bitch.

Fig. 10. Ureter at the graft showed cartilaginous metaplasia in the submucosa H&E X 100.



Fig(11)



Fig(12

Fig. 11. Part from the graft showed formation of cartilaginous plat H&E X 100.

Fig. 12. Kidney, showed multiple cystic dilatation of the renal tubules with atrophy in the renal parenchyma (hydronephrosis) H&E X 100.

DISCUSSION

End-to-end anastomosis is always feasible solution for short ureteral defects. Additional tissue is often necessary for longer segments. Compared with various prosthetic materials for reconstruction of lengthened ureteral defects, autogenous tissue grafts have fewer problems with bioincompatibility and foreign body reaction than different non degradable synthetic grafts that ended in failure due to bioincompatibility, a lack of peristaltic activity and salt deposition *(5,9)*.

Autogenous tissue grafts were introduced in an attempt to solve the problems of bioincompatibility and foreign body reactions. The first report of vascular grafting for ureteral reconstruction was in 1938 *(10)* , where a segment of common iliac artery was used to bridge ureteral defects in dogs. Since then, there have been various experimental applications of autogenous vein or artery graft to restore ureteral continuity *(11-14)*. However, results of ureteral reconstruction associated with urothelium replacement in the graft, vascular graft patency, anastomotic stricture and the effect of a peristaltic graft on urinary flow remain controversial.

In our study intravenous pyelography (IVP) at 12 weeks postoperatively showed that the left ureter was unstained while the right side showed passage of contrast medium through ureter and urinary bladder. Abdominal ultrasonography showed enlargement of the left kidney and dilation of the anechoic renal pelvis at 6 &12 weeks postoperatively. This finding was attributed to impair renal function and obstruction of the ureter at the graft due to obstruction of the anastomotic site. It has been reported that urography results no renal function return was seen in rats with ureteral reconstruction by vein grafting alone, without stent support *(15)*. Moreover, radiographs revealed that the graft was obstructed after 24 hours and the kidney showed signs of hydronephrosis which become severe 15 days postoperatively in dogs *(4)*. On the other hand, normal postoperative intravenous urograms was observed on the site at which segmental ureteral replacement with a segment of the saphenous vein, in the length of approximately 2 cm in all dogs *(3)*. Moreover it has been found that during postoperative urography results showed normal renal function in the animals with ureteral reconstruction using vein grafting aided by a stent, as well as in those with primary ureteral anastomosis *(15,16)*.

Regarding our macroscopical examination results revealed that complete obstruction of the graft lumen has been occurred. Anastomosis stricture in ureteral vein graft reconstruction may occur secondary to lowered intraureteral hydrostatic pressure *(17)*. A supporting stent seems to be one of the crucial factors for keeping the graft lumen open in the early postoperative phase *(15)*. Failure of the ureteral reconstruction using vein grafts without stents resulted from graft collapse.

Ureteral peristalsis is also essential for urinary flow to occur without obstruction, an ideal ureteral replacement should be mobile and capable of peristalsis *(17,18)*. The results of hydronephrosis and destruction of the kidney was thought to be due to interruption of the peristaltic wave by the arterial graft *(10,13)*. The kidney maintained normal function after ureteral reconstruction with vein graft with stent.

Histological finding revealed that ureteral reconstruction using autologus jugular vein graft resulted in necrosis and stenosis of the venous interponate with consecutive hydronephrosis. These may be attributed to inadequate nutrition of the vein obviously led to inflammation and in the long term to necrosis and fibrosis with severe stenosis or even complete closure of the reconstruction seat. Severe ureteral obstruction at the site of the graft and hydronephrosis were seen in the vein-graft without stenting *(4,15,16)*. On the other hand, specimen taken from the anastomosis, proved the vitality of the venous transplant *(3)*.

Vascular endothelium could be replaced by columnar epithelium, when the vein graft was used for common bile-duct reconstruction *(19)*. However, in ureter grafts, urine is presumed to be a less suitable medium than bile for the graft. The pH of urine is lower, and contains chemical irritants that only a transitional epithelium is naturally capable of withstanding, no transitional urothelium was seen in either arterial or venous grafts when they were used for

ureterovenoureterostomy in dogs *(10,11,17)*. Complete replacement of the vein graft by fibrous tissue, with no endothelial layer, the graft achieved patency in dogs *(14)*. On the other hand in the same model, a replacement of venous endothelium with transitional urothelium that the ingrowth of urothelium was also seen in long-segment ureteral replacement with prosthetic materials, and in urethral reconstruction with autogenous vein graft *(20)*. A progressive loss of the vascular endothelium, and replacement with the urothelium typical of the ureter, was seen in the stented vein grafts *(15,16)*.

Due to the failure, limitations and complications of this method, the results were disappointing and showed that the jugular vein is not an appropriate ureter substitute in bitches.

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الملخص العربي

إعادة بناء الحالب بالوريد الودجي الخارجي الذاتي في إناث الكلاب

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أجريت التجربة على سبعة من إناث الكلاب البالغة الصحيحة ظاهريا لدراسة امكانية إستبدال جزء من الحالب مع طعمة الوريد الودجي الخارجي في أناث الكلاب, حيث نقوم بملاحظة التغير في الوصلة بين الوريد والحالب وحالة الكلى ظاهريا ووظيفيا وهستولوجيا. تم فتح البطن حيث تم تحرير الحالب الأيسر و إستبدال ٢ سم منه مع طعمة الوريد الودجي الخارجي حيث تمت الخياطة للطعمة مع الحالب بإستخدام برولين (٠/٦). أظهر التصوير بالأشعة والمسح بالموجات فوق الصوتية للبطن بعد ٦ و ١٢ أسبوع في جميع الحيوانات الأنسداد الكامل للطعمة وظهور علامات التكيس في الكلى والذي كان على أشده بعد ١٢ أسبوع من الجراحة. لوحظ بالفحص النسيجي تحول النسيج تحت الغشاء المخاطي للطعمة إلى نسيج غضروفي بالإضافة إلى وجود تكيسات بأنابيب الكلية إلى جانب ضمور في النسيج الحشوي للكلية. أثبتت النتائج أن طعمة الوريد الودجي الخارجي الذاتي ليس بديل ملائم للحالب في إناث الكلاب.