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The ileopsoas tunnel, a new antireflux technique for ureteroileal reimplantation: an experimental study in dogs

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Abstract A new antirefluxing ureteroileal anastomosis is described in which the implanted ureter is placed between the ileal segment and psoas muscle. The procedure was studied in eight experimental dogs, which were observed for 20 weeks. Radiologic and bacteriologic examinations, necropsy assessment and histopathologic results provided evidence that this ileo-psoas tunnel technique allows a unidirectional, non-obstructed flow of urine. The technique could be applied when ileal replacement of the ureter is necessary or in association with continent bladder replacement.

Key words Ureter · Ileum · Implantation · Antireflux

In view of its deleterious effects on the renal reserve, several techniques for reflux prevention have been developed to complement the surgery of bladder substitution [1, 9, 10, 13]. Similarly, some investigators used a reflux-preventing valve when a segment of ileum was used for replacement of the ureter [8, 12, 15]. This valve was always constructed at the ileovesical junction. It could be argued that, at this position, the valve may cause urinary stasis in the ileal ureter. In a series of animal experiments, the feasibility of creating an antireflux mechanism at the proximal end of the ileal segment was studied and evaluated.

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Materials and methods

Experimental animals

Eight adult mongrel dogs weighing between 15 and 23 kg were used for the experiments. The procedures were carried out with the animals under general anesthesia. Thiopental sodium (20 mg/kg) was used for induction and maintenance of anesthesia, with endotracheal intubation and mechanical ventilation.

Operative procedure

The abdomen was explored through a midline incision. The left ureter was dissected and severed in its lumbar portion. The related part of the left psoas muscle was exposed. A segment of the terminal ileum 8 cm long was isolated and its oral end was closed. The continuity of the bowel was reestablished. The spatulated ureter was anastomosed end-to-side with 6-0 polyglactin to the back surface of the ileal segment 3 cm from the closed end (Fig. 1). The intact upper third of the ileal segment was then fixed at its medial and lateral borders to the psoas muscle with 3-0 polyglactin. In this way, the implanted part of the ureter was located in a tunnel between the ileal segment and psoas muscle (Fig. 2). The distal end of the ileal segment was anastomosed to a buttonhole in the bladder dome, leaving a 4-Ch ureteral stent in place for 10 days. Antibiotics and parenteral fluids were given for 5 days, followed by a fluid oral diet for 2 days and then solid food as tolerated.

Evaluation

The animals were observed for a minimum of 20 weeks. They were evaluated at 6 weeks postoperatively and immediately before being put to death. The evaluation included gravity retrograde cystography (water head 60 cm) and excretory urography. At necropsy after the final study, urine samples were obtained from the bladder as well as from both renal pelves for bacterial culture. The length of the ileopsoas tunnel was measured. Specimens including both kidneys, implanted ureter, ileum and psoas muscle were obtained for histopathologic examination.

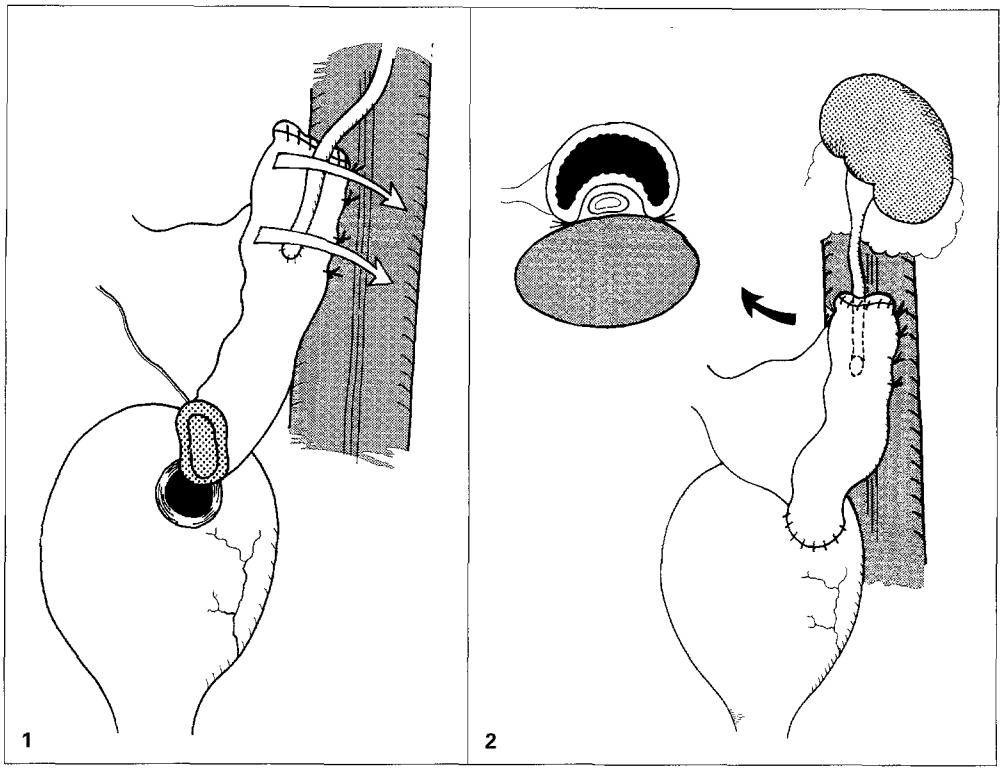


Fig. 1 The distal ureter is anastomosed end-to-side to the ileal segment about 3 cm from its closed end. The upper part of the ileal segment is then fixed to the psoas muscle at its medial and lateral borders, resulting in closure of this ileopsoas tunnel

Fig. 2 Final schema and cross-section of the ileopsoas tunnel. The ureter is placed between the ileal segment and psoas muscle

Results

All dogs survived the surgical procedure.

Radiologic study

In four dogs out of the eight, the reimplanted renal units had maintained perfect radiographic configuration with no evidence of reflux (Figs. 3, 4). In two dogs, excretory urography 6 weeks after operation showed hydronephrosis (one moderate, the other severe). Open revision and meatotomy for anastomotic strictures were required. Postrevision urograms showed improvement of the upper urinary tract with no evidence of reflux. In the remaining two dogs, cystography at 6 weeks showed reflux, due to disruption of the absorbable sutures fixing the ileal segment to the psoas muscle in one dog. The reflux disappeared following refixation. The reflux in the other dog was high-pressure reflux, which disappeared spontaneously in the final study (Table 1).

Bacteriologic study

The bladder urine samples were infected in all animals. The urine from the untouched control right renal pelves was sterile. The refluxing and obstructed left renal units showed positive bacterial growth, while urine samples from the uncomplicated units were sterile.

Histologic study

All tunnels were found between the ileal segment and psoas muscle (Figs. 5, 6). The length of the tunnel in the complicated renal units was relatively shorter (2.0–2.2 cm) than the others (2.5–4.2 cm). Gross examination showed normal-sized kidneys in all dogs except the two refluxing units, which showed small-sized kidneys with contracted parenchyma when compared to the nonrefluxing units. Histopathologic examination demonstrated the evidence of pyelonephritic changes in the infected renal units, in contrast to the noncomplicated units, which had sterile urine (Figs. 7, 8).

Discussion

The clinical result following replacement of the pathologic ureter with an ileal segment is a matter of controversy. Several authors have reported good results [4, 6, 7], while other studies have produced disappointing results [3, 11, 14]. Prout et al. reported that the results of their ten cases were entirely unsatisfactory [11]. Tanagho stated that incorporation of intact ileal segment should not be used in a closed urinary system. Failures were caused by high intraluminal pressure due to vesicoileal reflux, which finally led to hydronephrosis and deterioration of renal function [14]. Compared to the characteristics of the normal ureter, an intact ileal segment carries other inherent problems such as ineffective propulsive peristalsis for urine, electrolyte absorption, mucous secretion and bacterial infection.

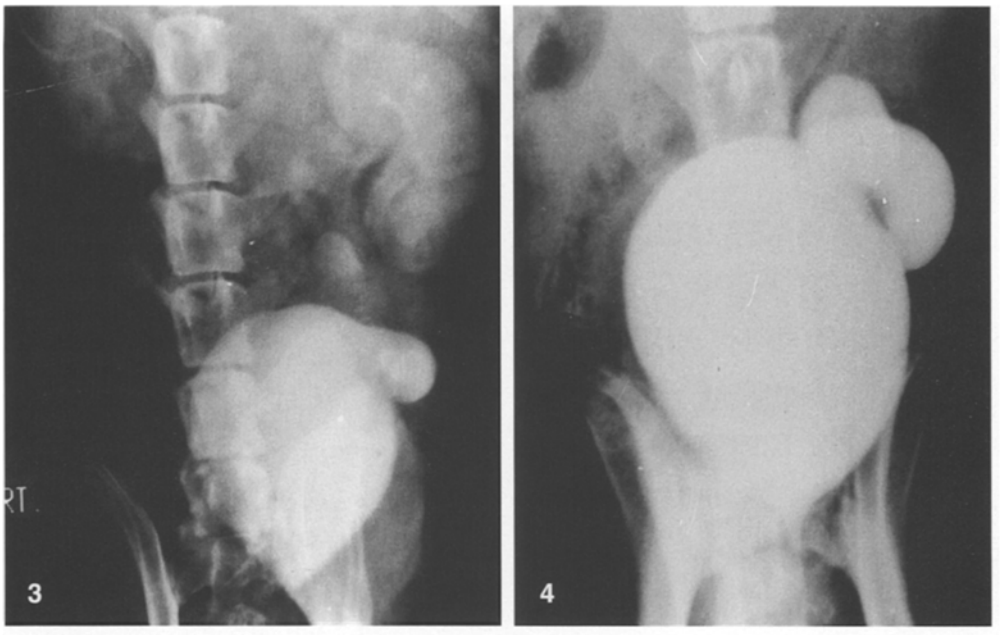


Fig. 3 Postoperative excretory urogram shows perfect configuration of the upper urinary tract

Fig. 4 Retrograde cystogram shows no evidence of reflux from the ileal segment

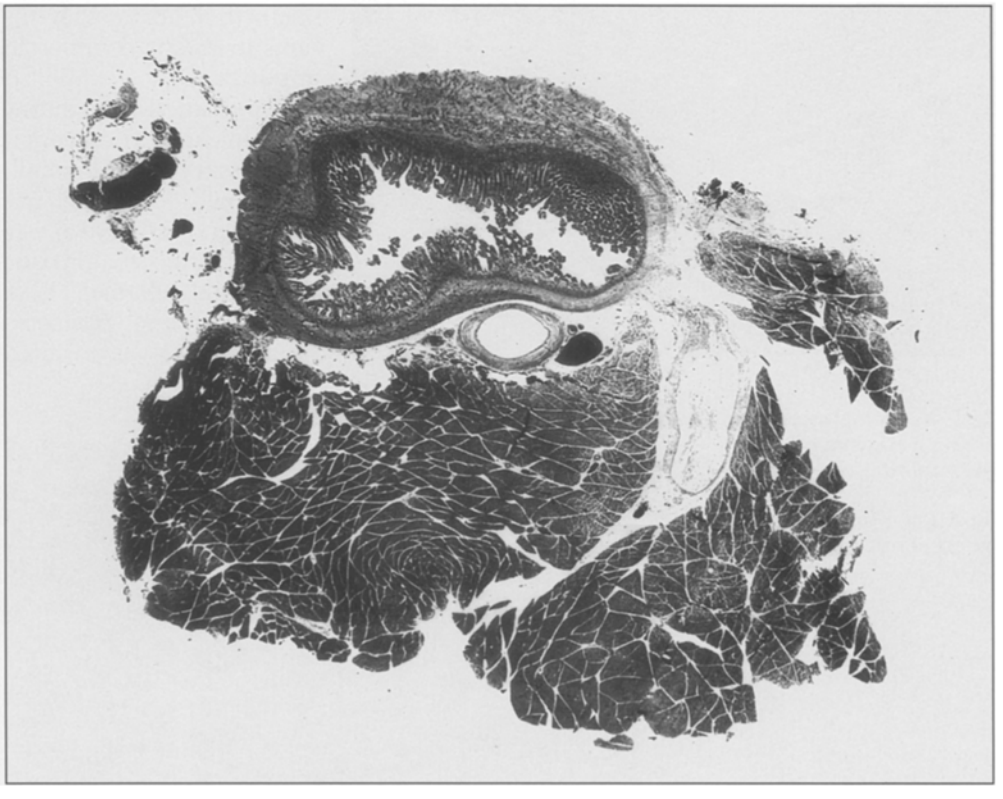


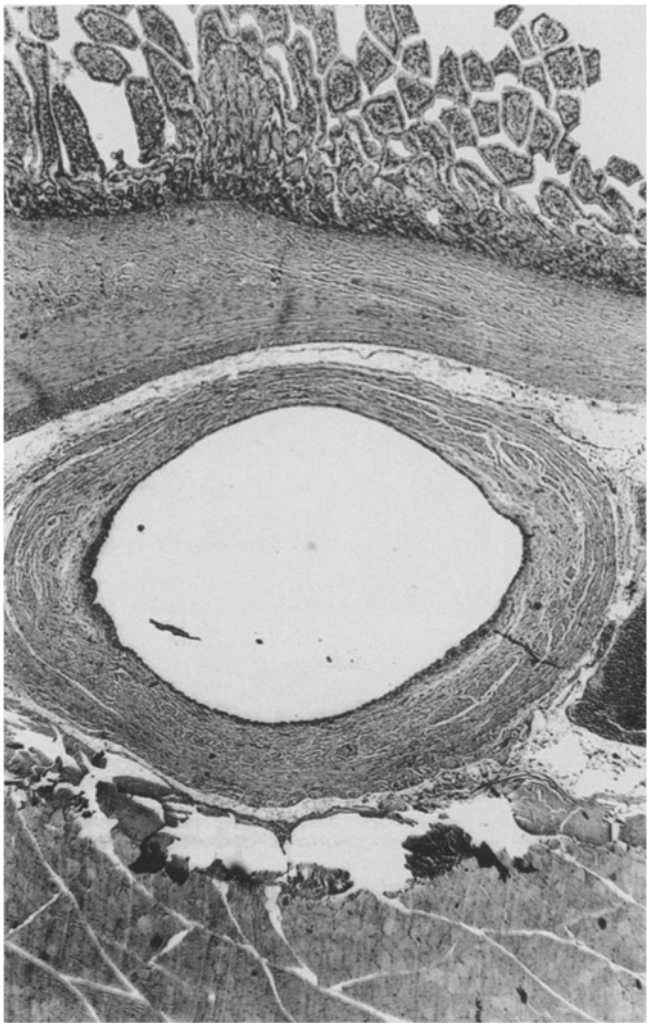
Fig. 5 Histologic findings of the ileopsoas tunnel. The ureter is located between the ileal segment and psoas muscle. H&E, ×10

Table 1 Results of the ileopsoas tunnel technique (in eight dogs)

6 weeks postoperatively		20 weeks postoperatively	
Obstruction	Reflux	Obstruction	Reflux
2[a]	2[b]	–	–

[a] Two dogs with obstruction required revision
[b] One dog required revision, the reflux disappearing spontaneously in the other dog

To overcome these problems, some investigators advocated tailoring the ileum to reduce its diameter [5, 16] and others tried to construct an antireflux valve at the vesicoileal junction by creating a submucosal tunnel [8] or a nipple valve [12, 15]. Shokeir et al. stated that tailoring of the ileal segment and antireflux nipple valve at the ileovesical junction provided



◀ **Fig. 6** Micrography of the implanted ureter. H&E, ×100

efficient unidirectional flow of urine with less mucous secretion [12]. But this procedure required metallic staples for stability of the valve, which could be a nidus for stone formation. Furthermore, the distal antireflux mechanism may increase the resistance of urine flow with subsequent ilatation of the ileal segment in the long-term follow-up.

We assumed that the most critical portion in the prevention of reflux could be the ureteroileal junction, because the intact ileal segment had high-pressure waves that might be transmitted to the kidney by ileoureteral reflux, resulting in parenchymal infection and functional deterioration.

The results of this study indicate that this ileopsoas tunnel technique was effective for reflux prevention in the majority of the dogs. An adequate length of tunnel without tension at the anastomotic site is a necessary prerequisite. The disruption of the tunnel in one dog indicates that the use of non-absorbable sutures to fix the ileum to the psoas muscle is of critical importance.

The creation of an antireflux system at the level of the ureteroileal junction with ileal substitution of the ureter is necessary since a small kidney with pyelonephritis was finally observed in the two dogs which had ileoureteral reflux at 6 weeks postoperatively.

Our proposed proximal antireflux technique is simple and reliable. The implanted part of the ureter is covered and protected from exposure to urine, which leads to a periureteral inflammatory response

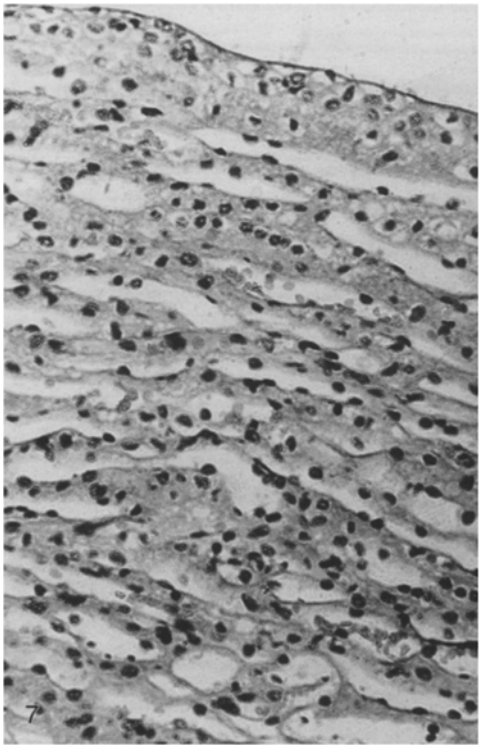


Fig. 7 Noncomplicated kidney shows no evidence of pyelonephritis. H&E, ×100

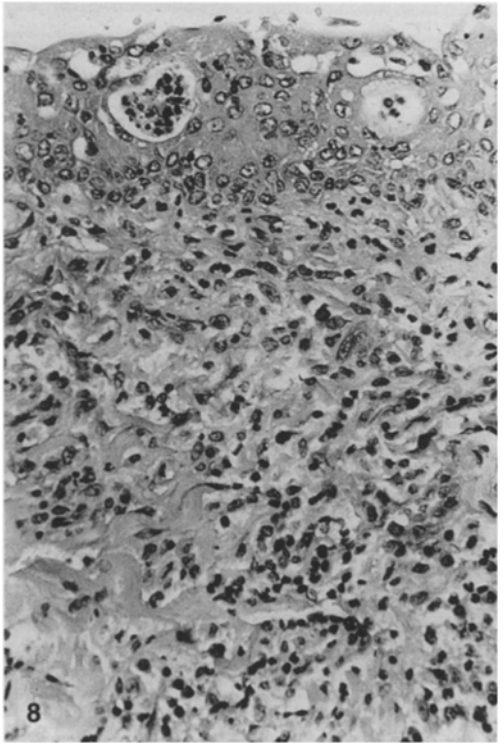


Fig. 8 Refluxing kidney shows pyelonephritic changes. H&E, ×100

[1]. The technique does not require staples or other synthetic materials. Moreover, it is suitable for dilated as well as normal ureter. The method is also applicable to patients in whom urinary diversion is required. It could be used with some techniques such as Studer's procedure [13], by fashioning the tunnel between the afferent isoperistaltic segment and the related psoas muscle.

References

1. Abol-Enein H, Ghoneim MA (1993) Optimization of ureterointestinal anastomosis in urinary diversion: an experimental study in dogs. III. A new antireflux technique for ureteroileal anastomosis: a serous-lined extramural tunnel. Urol Res 21:135
2. Abol-Enein H, Ghoneim MA (1994) A novel uretero-ileal reimplantation technique: the serous lined extramural tunnel. A preliminary report. J Urol 151:1193
3. Bazeed MA, El-Rakhawy M, Ashamallah A, El-Kappany H, El-Hammady S (1983) Ileal replacement of the bilharzial ureter: is it worthwhile? J Urol 130:245
4. Boxer RJ, Fritzsche P, Skinner DG, Kaufman JJ (1979) Replacement of the ureter by small intestine: clinical application and results of the ileal ureter in 89 patients. J Urol 121:728
5. Charghi A (1979) Ureteral replacement using a new variation of the tailored ileal segment. J Urol 121:598
6. Fritzche P, Skinner DG, Craven JD, Cahill P, Goodwin WE (1975) Long-term radiographic changes of the kidney following the ileal ureter operation. J Urol 114:843
7. Goodwin WE, Winter CC, Turner RD (1959) Replacement of the ureter by small intestine: clinical application and results of the ileal ureter. J Urol 81:406
8. Hendren WH (1978) Tapered bowel segment for ureteral replacement. Urol Clin North Am 5:607
9. Kock NG, Nilson AE, Nolen L, Sundin T, Trasti H (1982) Urinary diversion via a continent ileum reservoir: clinical experience. Scan J Urol Nephrol Suppl 49:23
10. Le-Duc A, Camey M, Teillac P (1987) An original antireflux ureteroileal implantation technique. Long-term follow-up. J Urol 137:1156
11. Prout GR Jr, Stuart WT, Witus WS (1963) Utilization of ileal segments to substitute for extensive ureteral loss. J Urol 90:541
12. Shokeir AA, Gaballah MA, Ashamallah AA, Ghoneim MA (1991) Optimization of replacement of the ureter by ileum. J Urol 146:306
13. Studer UE, Gerber E, Springer J, Zingg EJ (1992) Bladder reconstruction with bowel after radical cystectomy. World J Urol 10:11
14. Tanagho EA (1975) A case against incorporation of bowel segments into the closed urinary system. J Urol 113:796
15. Tscholl R, Tettamanti F, Zingg E (1977) Ileal substitute of ureter with reflux-plasty by terminal intussuception of bowel: animal experiment and clinical experience. Urology 9:385
16. Waters WB, Whitmore WF, Lage AL, Gittes RF (1981) Segmental replacement of the ureter using tapered and non-tapered ileum. Invest Urol 18:258

Editorial comment

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Ureteroileal anastomosis in ureteral replacement as well as in orthotopic bladder replacement and supravesical diversion continues to pose a dilemma. The reoperation rates of an average of 7% are significant and are almost universal to all the techniques available and suggested for use. In the light of the continuing debate as to whether there is an advantage of one technique over another, the technique proposed in this presentation is of interest and worthy of consideration.

1. It is conceivable that reflux prevention by the proposed technique is efficient. However, reflux is not the problem in urinary diversion and the debate continues as to whether reflux prevention is necessary at all.
2. The direct ureteroileal anastomosis in this technique is exactly the same as in any other. So it is difficult to understand why this technique, despite being very innovative, should have any significant advantage. The problem seems to be the direct contact of the urine in the critical zone where the urothelium and intestinal mucosa meet.
3. The reoperation rate the authors present is not negligible (three out of eight dogs). It is even higher than that reported in human diversions. However, this may be attributed to the experimental character of the study.
4. Any attempt to reduce the stenosis rate at the ureteroileal anastomosis is appreciated at the time of orthotopic bladder replacement. So the new concept and the new idea of the authors is certainly a welcome addition to the armamentarium of urinary diversion. However, for the reservoirs mostly used where there is no tubular afferent segment, it is not suitable. For ureteral replacement where the diversion is done in the patient's genuine bladder, it is of much more interest. However, this is a very infrequent operation.

Reply to editorial comment

This technique was devised as an antireflux technique whenever an ileal replacement of the ureter is indicated. Although the indications for such a procedure are infrequent in the Western literature, it is certainly not uncommon in other regions [1, 2]. The

operation could also be applied in connection with bladder substitution if a long afferent limb was utilized. This is not a technique which is routinely employed or favored by us [3], but it could be used if the ureters had to be cut too high because of an associated pathologic condition. Furthermore, we feel that "with bladder substitution" an antireflux mechanism is necessary; otherwise there is a serious risk of development of chronic pyelonephritis in the long term [4].

References

1. (1991) Optimization of replacement of ureter by ileum. J Urol 146:306
2. Shokeir, AA, Ghoneim MA (1995) Further experience with the modified ileal ureter. J Urol 154:45
3. Abol-Enein H, Ghoneim MA (1994) A novel uretero-ileal reimplantation technique: the serous lined extramural tunnel. A preliminary report. J Urol 151:1193
4. Kristjansson A, Abol-Enein H, Alm P, Mokhtar AA, Ghoneim MA, Mansson W (1995) Substitution cystoplasty and reflux nephropathy in a canine model, a preliminary report. Continent urinary reconstruction, Second international meeting, Mainz, 1995

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