

## A Model for a Bladder Replacement Plasty by an Ileal Reservoir – An Experimental Study in Dogs

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**Summary.** Cutaneous urinary diversion requires appliances, unless a pouch and a valve mechanism are used (Kock-pouch). In order to avoid a stoma, repeated self-catheterizations, and the complications which may occur from malfunction of the distal valve, we created a modified ileal pouch with the advantages of a low-pressure system with good capacity and no reflux. By anastomosing the distal part of the reservoir to the urethra and using the male patient's own sphincter, the second nipple can be avoided and a urostoma is obviated. The feasibility of this procedure has been studied in 4 dogs.

**Key words:** Urinary diversion, Ileal reservoir, Bladder replacement plasty, Modified Kock-pouch.

### Introduction

Urinary diversion is inevitable if the urinary bladder has to be removed completely, as in cancer surgery, and many modes of urinary diversion have been proposed. The ileal conduit according to Bricker [2] has been the preferred method of diversion by most urologists. Unlike the ureterosigmoidostomy [5], which least affects the patient's integrity but cannot be performed in all patients, the ileal conduit as well as other diversions (jejunum, colon conduit, cutaneous ureterostomy) requires the use of external appliances. Although this represents a major concern to patients when it is first proposed to them, almost all patients rapidly become accustomed to the urostomy with no severe physical or physiological impairment [9]. The continent ileostomy (Kock-pouch) [7], ileocecostomy [1] or cecoileal conduit [10] free the patient from wearing a bag. The nipple valve between the pouch and the skin, requiring catheteriza-

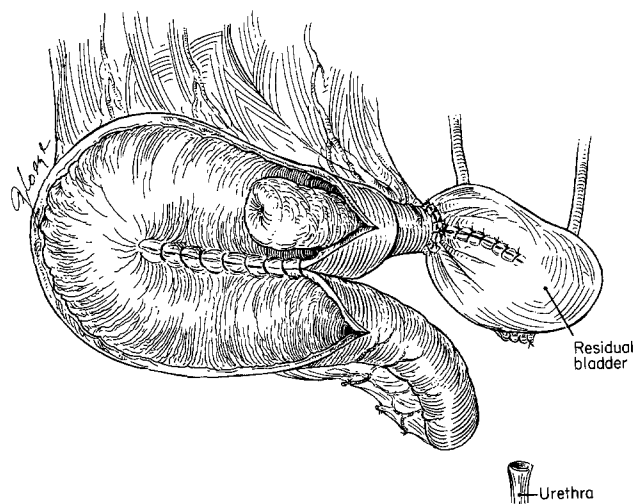
tion several times daily, is often subject to malfunction and is the cause of re-operation in many cases [1, 8, 10]. Moreover, a stoma is still present. An interesting alternative used by Camey [3] in male patients after radical cysto-prostatectomy, consists of suturing the antimesenteric border of a U-shaped ileal loop to the proximal urethra and anastomosing each ureter to either end of the ileal segment [3]. The main disadvantage is the limited capacity of the ileal reservoir necessitating 7–8 micturitions per 24 h and resulting in nocturnal incontinence in some patients [3].

We thought that it would be worthwhile to combine the advantages of the Kock-pouch (good reservoir capacity by exclusion of peristalsis, protection of the upper urinary tract by an anti-reflux nipple) with the advantages of enterocystoplasties (no stoma, use of the patient's own sphincteric mechanism). Therefore, we studied the feasibility of modifying and combining each of those techniques in experimental surgery in dogs.

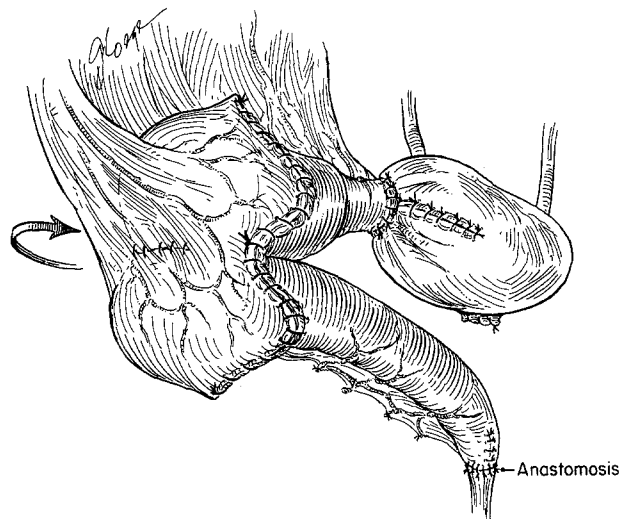
### Materials and Methods

**1. Dogs.** Prior to the experiment reported herein, preliminary work with a gut urinary reservoir and intussusception of the bowel as a valve was done in 10 dogs to determine feasibility of the surgical procedure. From the results of that pilot study evolved the concept and procedure described herein, performed in 4 male dogs, weighing 18 to 23 kg. Since a permanent postoperative drainage of the pouch could not be guaranteed by use of catheters due to clotting and removal by the dogs urine was diverted by a vesicostomy in 2 dogs and by a fistula between the ileal pouch and the skin in the other 2 dogs. Contrary to the conditions in humans after a radical cysto-prostatectomy, the ureters were not anastomosed directly to the proximal end of the ileal segment. Knowing that this is feasible in humans, we wanted to avoid complications from the uretero-ileal anastomosis and thus avoid stenting of the ureters.

**2. Operative Procedure.** A radical prostatectomy and partial resection of the bladder were performed, leaving the trigone, uretero-vesical junction and the blood supply of the bladder intact. Approximately 40 cm of the ileum, with the distal border of resection being 15–20 cm proximal to the ileo-cecal valve, was isolated from the gut with



**Fig. 1.** Schema of the surgery. After radical prostatectomy and partial resection of the bladder (see text), a pouch is made from ileum, with an antireflux nipple only at the proximal end



**Fig. 2.** Closure of the pouch. To obtain sufficient length for anastomosing the distal part of the ileal segment to the proximal urethra, the corresponding mesoileum must be severed. However, the arcades are preserved to assure good blood supply to the anastomosis

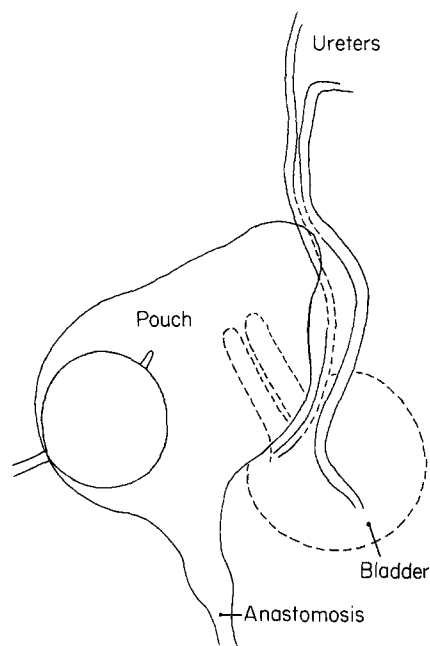
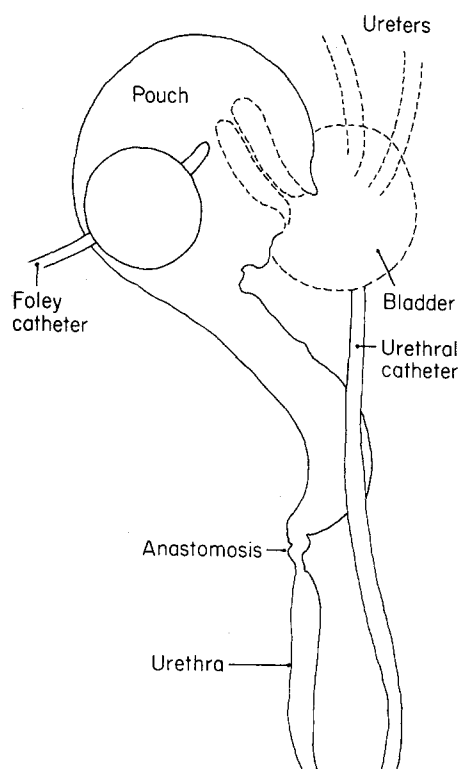
its mesentery intact. The continuity of the gut was reestablished by a single layer running suture. Beginning 11 cm distal to the proximal end, the isolated segment was opened on its antimesenteric border over a distance of 20 cm. This part was then folded like a "U" and the adjacent edges of the U were sutured together with one layer of continuous suture, locked at every 4th stitch (Fig. 1). The serosa of the proximal, unopened ileum was cauterized longitudinally in 2–3 mm intervals and the nipple was intussuscepted, with 1 cm wide circular strip of fascia placed in between. The pouch was then closed by a single layer running suture, to fix the bottom of the U to the distal point of the 2 conjoined edges of the "U" shaped reservoir (Fig. 2). The proximal end of the segment was sutured end-to-side to the residual bladder, and the distal end (having no nipple) was anastomosed to the end of the urethra by interrupted sutures, after triangular resection of the distal antimesenteric border of the ileum to compensate for the differences in diameter. All anastomoses were effected with 3/0 polyglycolic acid. No stents were used.

## Results

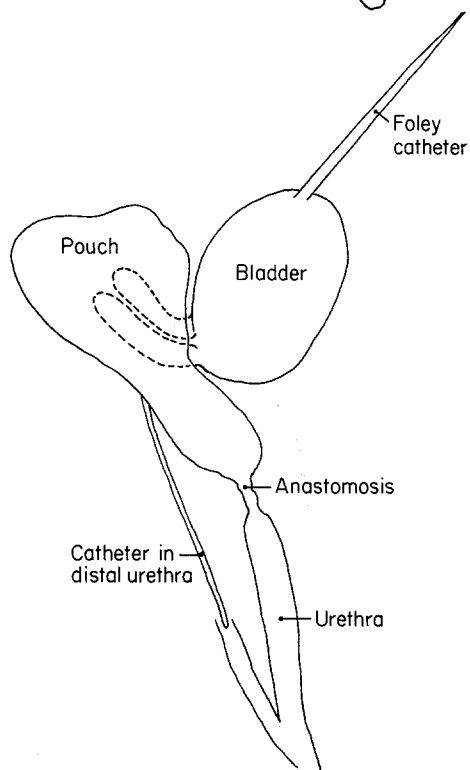
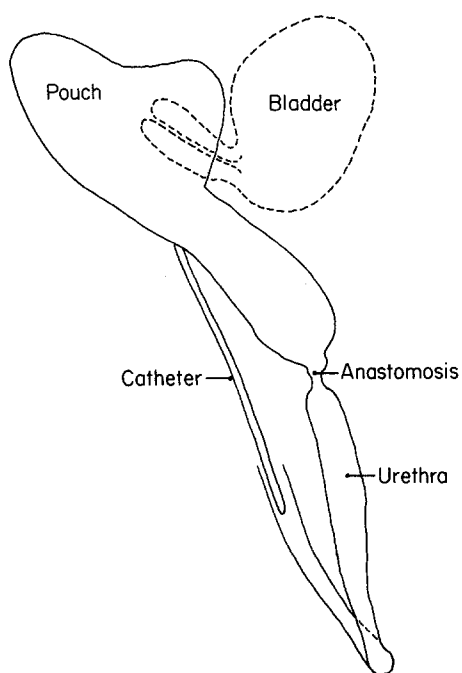
All 4 dogs survived the surgical procedure. No complications directly related to the surgical technique itself occurred. However, one dog had to be sacrificed after two weeks because of extensive wound infection. Necropsy showed normal upper urinary tracts, healing of the bowel sutures and a patent intestino-urethral anastomosis. The pouch had a capacity of approximately 150 ml with the nipple intact. A second dog had to be sacrificed after 10 days because of acute deterioration subsequent to a primarily normal post-operative course. Necropsy showed small bowel invagination caused by tapeworms 50 cm proximal to the completely healed end-to-end anastomosis. The modified lower urinary tract looked fine, with no leakage of the pouch or the other anastomoses. Dog #3, having a fistula between the pouch and the skin, had radiographic controls 6 weeks after surgery. Figures 3a/b show a good capacity of the pouch despite persistent drainage through the surgical fistula and a patent anastomosis with the urethra. In the intravenous urogram, the ureters are contrasted on both sides after 7 minutes and are of normal size. The dog died from allergic reaction to the contrast medium. Dog #4, with a fistula of the remaining bladder (vesicostomy), had a radiographic evaluation after 10 weeks (Fig. 4a/b), showing the same findings: a patent anastomosis with the urethra, a good capacity of the pouch (which never contained larger amounts of urine since it was diverted through the vesicostomy) and no reflux through the nipple into the residual bladder shown in Fig. 4b.

## Discussion

The number of dogs used is admittedly small and long-term follow-up was compromised by lethal complications which, however, are only indirectly related to the experiment. Nevertheless, the experiments could show that this method of creating a urinary reservoir with anastomosis to the urethra is feasible, at least in dogs. No additional experiments are needed to demonstrate that a low pressure system and a good capacity can be achieved; this work was done years ago by Kock and his coworkers [4]. Goodwin [6] emphasized this principle earlier when performing ileocystoplasties for bladder enlargements. A low pressure system is essential if continence is to be achieved when bowel is used as a bladder replacement plasty. As long as the tubular structure of the ileum is left intact, the pressure caused by peristalsis will exceed the resistance of the urethral sphincter and, in addition, good capacity in a segment of ileum cannot be obtained because of premature onset of peristalsis. Suppressing the high pressure also makes reflux less likely, but voiding from the bladder replacement plasty must be achieved solely by abdominal straining which can be expected to leave significant residual urine. Self-catheterization may therefore be needed in some patients.



**Fig. 3a/b.** Dog # 3. The surgical fistula between the pouch and the skin is occluded by traction on a Foley catheter. A second catheter is placed in the distal urethra. Filling by contrast medium shows a good capacity of the pouch, no reflux through the nipple towards the ureters and an open urethral anastomosis (a). The urogram shows non-dilated ureters with passage of the contrast medium into the deconfigured pouch (oblique position) which has an indwelling Foley catheter (b)



**Fig. 4a/b.** Dog # 4, having a vesicostomy (see text). Retrograde filling through catheter placed in distal urethra shows a patent anastomosis, good capacity of the pouch (although never filled with urine) and no reflux through the nipple (a) into the adjacent residual bladder shown in b by filling it through a Foley catheter inserted through the vesicostomy

Further advantage of this procedure, when compared to the technique used successfully by Camey, is less dependency on the length of the meso-ileum. This is a limiting factor when the middle of the antimesenteric border of the U-shaped ileum is to be anastomosed directly to the proximal urethra. When using the modified Kock-pouch, additional length can be obtained by severing the most distal part of the meso-ileum with preservation of the vascular arcades (Fig. 2).

The advantages of our technique compared to the Kock-pouch with diversion to the skin are the omission of the distal nipple and the lack of a stoma through which a catheter must be inserted several times daily.

The need for intellectually controlled micturition by abdominal straining and coordinated opening of the sphincter as well as the possibility that catheterization may be required when this kind of bladder replacement plasty is performed, are the reasons for the surgical fistula. Nevertheless, the results obtained when combining modified procedures that have been successfully used in human beings encourage the pursuit of this kind of bladder replacement plasty, and we believe that it should be attempted in carefully selected male patients.

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