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The Disadvantages of Reflux in Uretero-Ileal Cutaneous Anastomoses for Supravesical Urinary Diversion

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Summary. Radiological and histological evidence from animal studies is presented to show that renal units subjected to reflux of urine after diversionary surgery develop pyelonephritis. It is suggested that anti-reflux diversionary procedures be developed.

Key words: Urinary diversion, reflux, pyelonephritis.

Permanent supravesical urinary diversion by bilateral cutaneous ureteroileostomy as described by Bricker in 1950 (1) is a common surgical procedure today. This operation is used primarily for patients with: (a) neurogenic bladder dysfunction and (b) urinary diversion after radical pelvic cancer surgery. In the former situation patients tend to be younger, often in the pediatric age group. Therefore, this procedure is being performed on patients who may be expected to survive for decades. The operation, as performed by most urologists, produces a urinary tract in which there is free, low-pressure reflux from the ileal segment to the ureters and kidneys (2). Pathogenic bacteria have been reported growing in the ileal segment in 70-100% of those patients studied (3, 4). Residual urine in the segment is commonly reported (5). Radiological evidence of chronic pyelonephritis in this group of patients is reported to vary from 10-60% and to increase with time (3, 4, 6, 7, 8). Long-term complications of this operation include acute and progressive chronic pyelonephritis, renal calculus formation, uretero-ileal obstruction, and stomal problems (3). The role of reflux in deterioration of renal function in these patients is unknown. It is often stated that reflux does not cause upper tract damage because the ileal segment is (a) a conduit, not a reservoir and, (b) a low-pressure system (9). This premise is not consistent with the demonstrated effects of reflux of infected urine from the bladder to the kidneys. We questioned if this reflux of urine was benign and undertook a series of experiments in dogs to determine the role of reflux in the development of pyelonephritis in kidneys which have been diverted.

Materials and Methods

Thirteen adult female dogs were subjected to varying forms of supravesical urinary diversion. Four animals had conventional Bricker procedures. In attemps to create a non-refluxing system, 2 animals had a Bricker procedure with submucosal tunneling of the ureters and a third had a Bricker procedure with creation of ureteral nipples. Six dogs were subjected to a procedure in which the left ureter was implanted in the standard spatulated fashion into an isolated segment of ileum. The right ureter and right hemitrigone were preserved and the entire heimtrigone was anastomosed to the end of the ileal segment (Fig. 1). A stomal cannula was used to obviate cutaneous urine burns for humane reasons and to prevent stomal stenosis. All animals received penicillin and streptomycin for 5 days post-operatively and then no further antibiotics were administered. Pre-operative and post-operative intravenous urograms were performed on all animals, as well as post-operative ileal segment dye studies. Two animals died in their early post-operative period. The remainder were sacrificed after 2 months. Autopsies were performed on 10 of the animals.

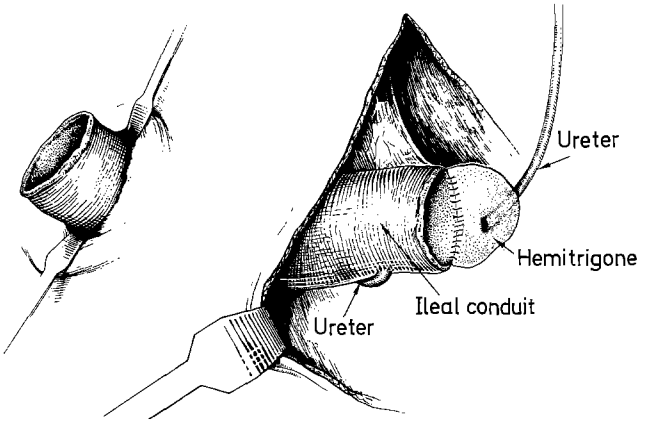


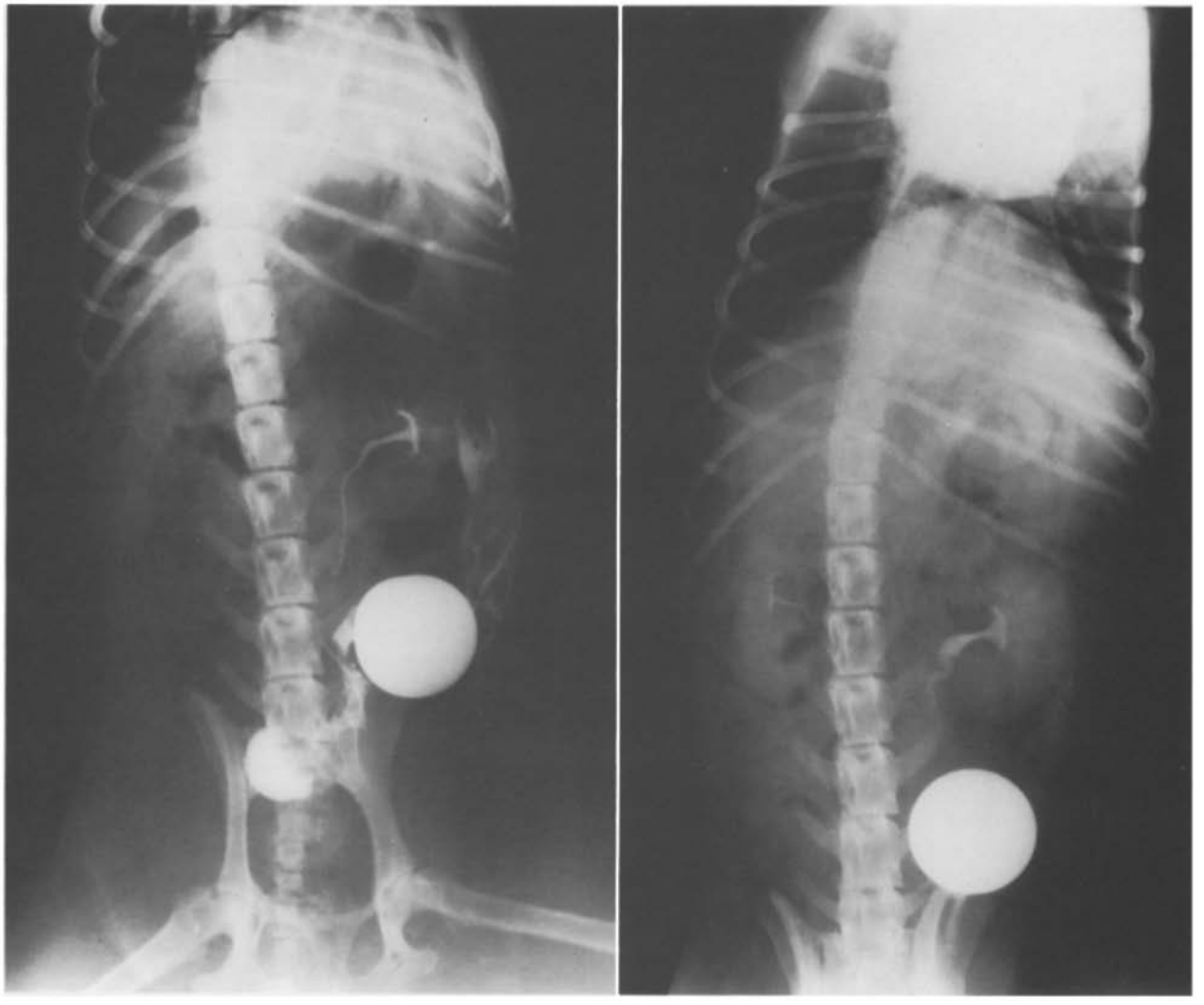
Fig. 1. Uretero-ileo-cutaneous anastomosis combined with hemitrigonal-ileal anastomosis

Results

All pre-operative intravenous pyelograms were normal. Post-operatively, in the 4 animals subjected to a conventional Bricker procedure, all 8 renal units showed changes on intravenous urography. These changes varied from minimal stasis and dilatation of the collecting system to grade II ureteronephrosis with caliectasis and clubbing. None of the 8 units were obstructed and all refluxed freely.

The animal subjected to the standard Bricker procedure with nippling of the ureters died in the early post-operative period from sloughing and obstruction of the nipples.

Two animals had a Bricker procedure with submucosal tunneling of the ureters into the ileum. All 4 renal units involved showed obstructive



Figs. 2 and 3. Fig. 2. Post-operative retrograde ileal conduit dye study on a dog in which a left uretero-ileo-cutaneous anastomosis combined with a right hemitrigonal-ileal anastomosis was performed. Free reflux into the left renal unit is demonstrated while there is no reflux into the right renal unit. The opaque circular object on the left side represents a collecting device. - Fig. 3. Post-operative IVP on same animal as in Fig. 2. Stasis, dilatation and calyceal clubbing is present in the left renal unit while the right renal unit remains normal

changes on post-operative intravenous urography. None of these 4 units refluxed.

In the 6 animals who underwent creation of an isolated ileal segment with left spatulated uretero-ileal anastomosis and right hemitrigonal anastomosis, 4 left renal units refluxed while none of the 6 right renal units refluxed (Fig. 2). The other 2 left renal units were obstructed at the uretero-ileal anastomosis. On intravenous pyelography the left renal units all showed changes consistent with pyelonephritis while all 6 of the right renal units remained normal (Fig. 3). All urine cultures obtained from a catheter placed into the base of the ileal segment revealed a heavy growth of mixed flora, with the most common pathogens being E. coli and Proteus mirabilis. On post-mortem histological examination none of the kidneys were completely normal. Diffuse changes of acute and chronic pyelonephritis were found in all kidneys in which reflux had been demonstrated, as well as in all kidneys which had been obstructed at the ureteroileal anastomosis. The kidneys in which neither reflux nor obstruction was demonstrated showed focal areas of glomerulitis and/or nephritis which was nowhere

Table 1. Results of various forms of urinary diversions

Operation	Pre-OP IVP	Degree of changes on post-OP IVP		Reflux on ileal dye study		Post-mortem changes in kidneys	
		L	R	L	R	L	R
1. Bilateral cutaneous ureteroileostomy	WNL	+	+	yes	yes	P	P
2. "	"	++	++	yes	yes	X	X
3. "	"	+	+	yes	yes	P	P
4. "	"	+	+	yes	yes	P	P
5. Bilateral cutaneous ureteroileostomy with nippling of ureters	"	+++	+++	no	no	X	X
6. Bilateral cutaneous ureteroileostomy with tunneling of ureters	"	+++	+++	no	no	P	P
7. "	"	+	+	no	no	P	P
8. Right hemitrigonal-ileal anastomosis with left ureteroileal anastomosis	"	+	0	no	no	P	NL
9. "	"	+	0	no	no	P	NL
10. "	"	+	0	yes	no	X	X
11. "	"	+	0	yes	no	P	NL
12. "	"	++	0	yes	no	P	NL
13. "	"	+	0	yes1	no	P	NL

Post-OP studies obtained 6-8 weeks
Post-operatively. Animals were sacrificed at 2 months.

0-WNL
+-Moderate stasis and dilatation
++-Obvious stasis and dilatation with changes of chronic pyelonephritis.
+++-Obstruction
X-No post performed
P-Diffuse acute and chronic pyelonephritis
NL-Normal kidney

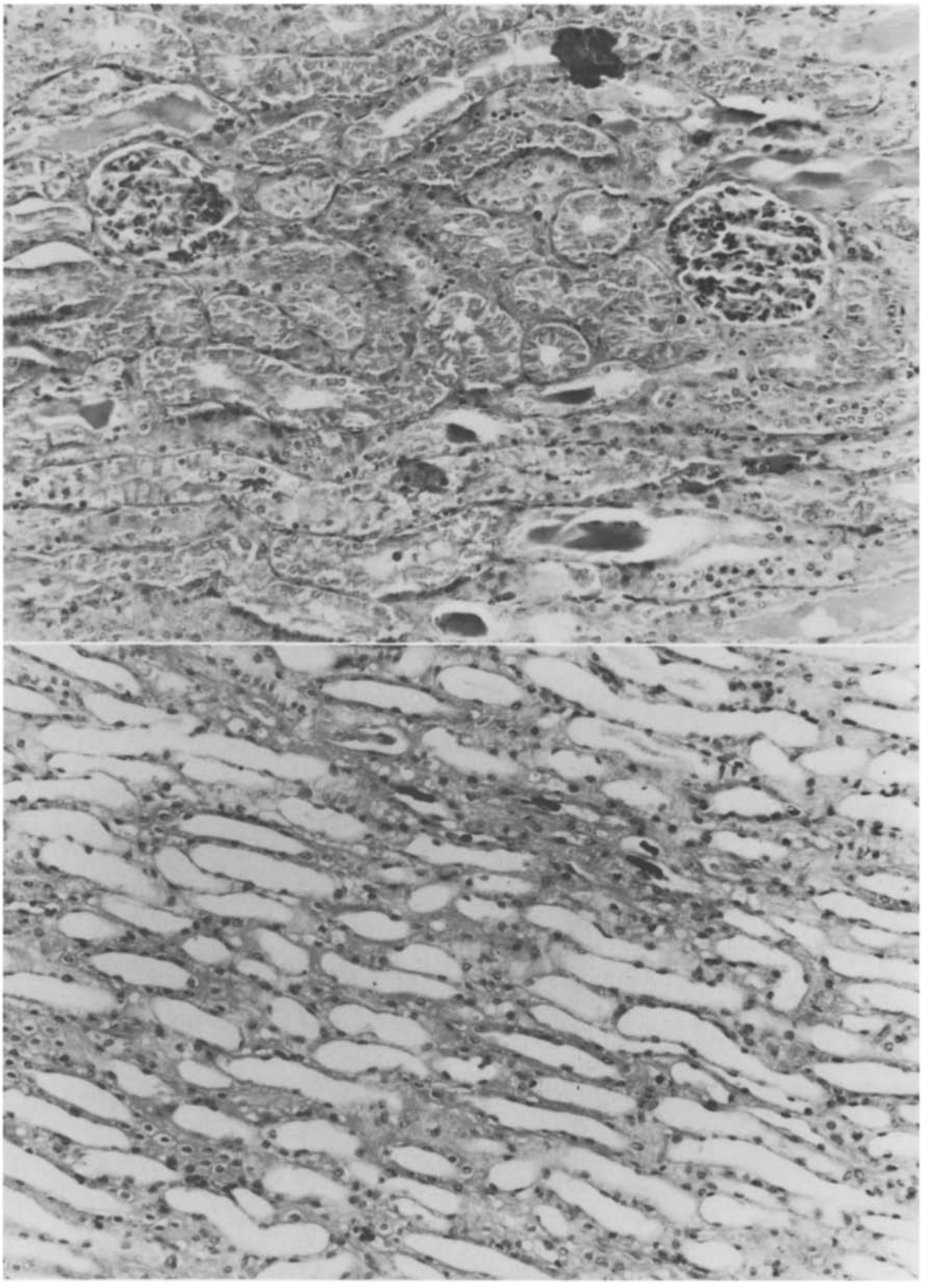
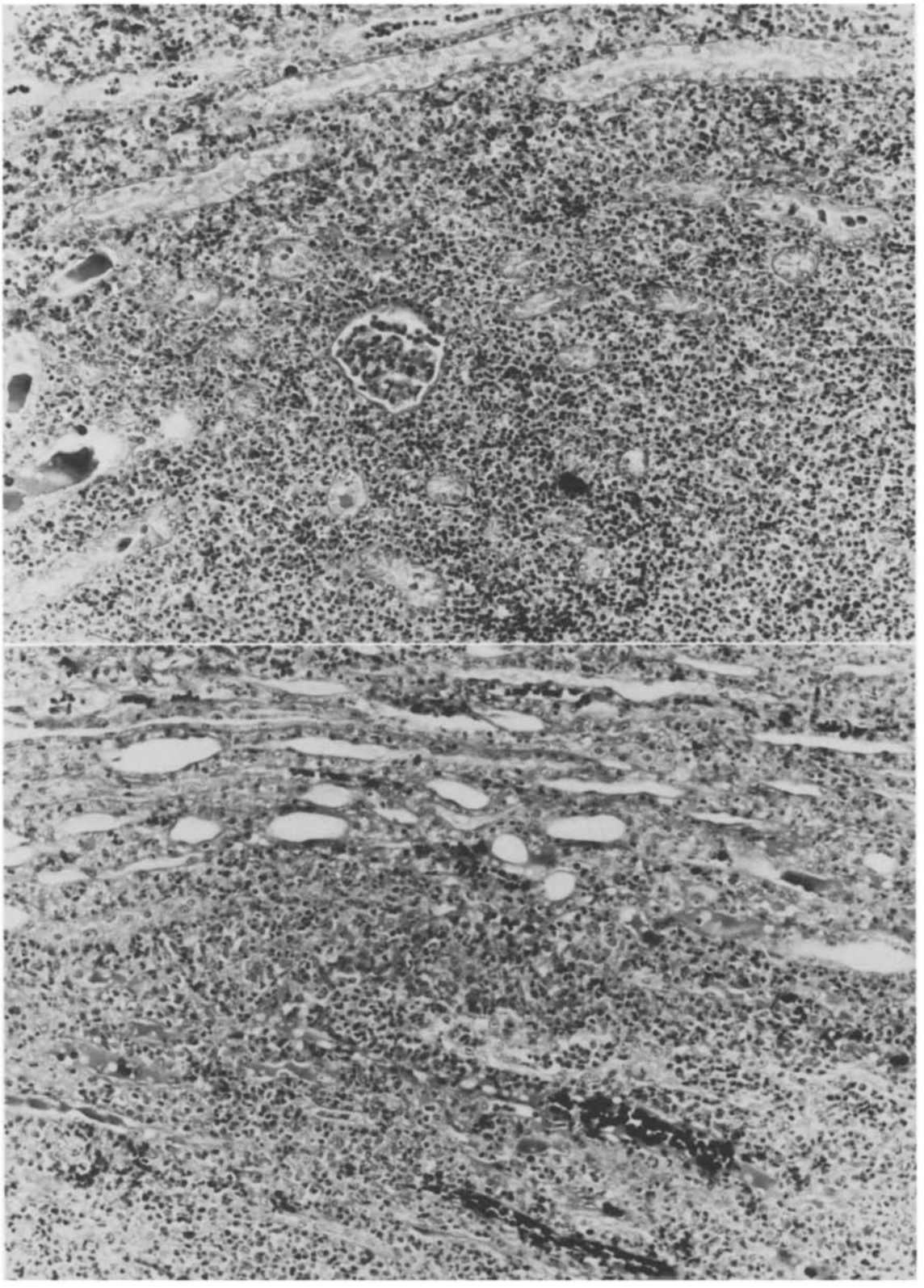


Fig. 4. Photomicrographs from kidneys of same animal as in Fig. 1 and Fig. 2.

A. Left renal cortex - extensive pyelonephritis
B. Left renal medulla - extensive pyelonephritis



C. Right renal cortex - no pyelonephritis - mild post-mortem autolysis
D. Right renal medulla - no pyelonephritis

near as extensive as in the kidneys where reflux had occurred (Fig. 4). These findings correlated with the radiological findings previously described (Table 1).

Discussion

Most techniques of ileal diversion today create free reflux of infected urine to the kidneys. This is presently considered to be a satisfactory operative result. Indeed, an ileal conduit which doesn't reflux is generally considered to be obstructed at the uretero-ileal anastomosis (10). We questioned the assumption that refluxing ileal conduits are desirable and performed diversionary procedures devised so that the animal served as his own control. Radiologic and histologic evidence is presented to show that diverted kidneys into which there is reflux of infected urine developed extensive pyelonephritis. Obstruction produced similar changes. Unobstructed, non-refluxing units showed no changes radiologically and the histologic changes were minimal.

These experiments suggest that the reflux created by ileal diversionary procedures now in general use is not benign and may be a significant factor in the development of acute and progressive chronic pyelonephritis in later years. Anti-reflux procedures for supravesical diversion of urine should be developed, particularly in view of the expected long-term survival of many patients.

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