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# MULTI-INSTITUTIONAL EXPERIENCE WITH THE GASTROINTESTINAL COMPOSITE RESERVOIR

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## ABSTRACT

Purpose: We evaluated multi-institutional experience with the gastrointestinal composite reservoir in patients with metabolic acidosis, the short bowel syndrome, severe pelvic radiation and/or renal insufficiency.

Materials and Methods: At 4 institutions 33 patients underwent construction of a gastrointestinal composite reservoir, including 19 with the short bowel syndrome, 13 with metabolic acidosis and 7 who also had renal insufficiency. A total of 16 patients underwent conversion of a previous diversion and the remaining 17 received new urinary diversion. Charts were reviewed for the metabolic impact of the gastrointestinal reservoir as well as any long-term sequelae.

Results: At a mean followup of 54 months there was a significant ($p \leq 0.05$) improvement in mean preoperative and postoperative serum chloride (106 versus 102 mEq./l.), serum bicarbonate (23.3 versus 25 mEq./l.) and serum pH (7.36 versus 7.4). Mean serum creatinine did not significantly differ during followup in patients with normal renal function or renal insufficiency. Complications were not different than those of standard intestinal or gastric reservoirs.

Conclusions: The gastrointestinal reservoir has provided an excellent metabolic balance in a large series of compromised patients with few side effects. We believe that the gastrointestinal composite reservoir represents the urinary diversion of choice when standard intestinal urinary reservoirs cannot be created in the setting of metabolic acidosis, the short bowel syndrome and severe pelvic radiation. However, the value of the gastrointestinal composite in the setting of renal insufficiency remains undetermined.

KEY WORDS: urinary diversion, bladder, short bowel syndrome, intestines, stomach

Various bowel segments have been used for urinary reservoir reconstruction. Unfortunately these reservoirs are limited by metabolic complications. Acid base derangements are common because of the absorptive and secretory properties of pure intestinal or gastric reservoirs.[1,2] Furthermore, pure intestinal or gastric reservoirs are associated with multiple local complications, including mucous production, urolithiasis, urinary tract infection and the hematuria-dysuria syndrome.[3,4]

Lockhart et al first reported the concept of combining gastric and intestinal segments as a composite urinary reservoir to temporize the metabolic complications associated with pure intestinal urinary reservoirs.[5] By combining gastric and intestinal segments as a composite urinary reservoir, electrolyte neutrality would theoretically be achieved. Shortly thereafter McLaughlin et al from Indiana demonstrated the use of stomach combined with other intestinal segments in pediatric lower urinary tract reconstruction.[6] In addition, variations of the gastrointestinal composite reservoir have been reported by others using an extension of the composite gastric segment as a catheterizable efferent limb.[7,8] Since these first reports, Lockhart[9] and Austin[10] et al have demonstrated the short-term and long-term metabolic advantages of a gastrointestinal composite urinary reservoir in patients with preexisting metabolic acidosis or the short bowel syndrome. More recently a combined experience was reported demonstrating the long-term metabolic benefits in the pediatric population with similar preexisting conditions.[11] We evaluated the gastrointestinal reservoir from a multi-institutional experience standpoint. The long-term metabolic impact of the gastrointestinal reservoir was reexamined as well as the surgical outcome.

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## MATERIALS AND METHODS

At 4 institutions 15 male and 18 female patients 4 to 71 years old (average age 36) underwent construction of a gastrointestinal composite urinary reservoir from 1990 to 1998. The original diagnosis was pelvic malignancy in 12 patients (prostate, bladder or cervical cancer), of whom 8 received external beam radiation and 4 had a vesicovaginal fistula. In addition, there was neurogenic bladder in 9 patients, exstrophic anomalies in 9, and bladder agenesis, bilateral ectopic ureters and posterior urethral valves in 1 each. Patients were selected for composite urinary reconstruction based on the short bowel syndrome, metabolic acidosis or renal insufficiency (fig. 1). A composite urinary reservoir was constructed at 1 stage in 17 cases. However, in 16 cases staged urinary reconstruction was done using a composite of bowel and gastric segments, including an initial conduit in 12, initial gastrocystoplasty in 3 and ureterosigmoidostomy in 1 (fig. 2).

Briefly, in patients without preexisting noncontinent diversion approximately 20 to 30 cm. of ileum or colon were obtained as the bowel segment of the urinary reservoir. Those with an existing conduit generally did not require bowel harvesting. The conduits were detubularized and used as an augmentation patch for reservoir construction. The

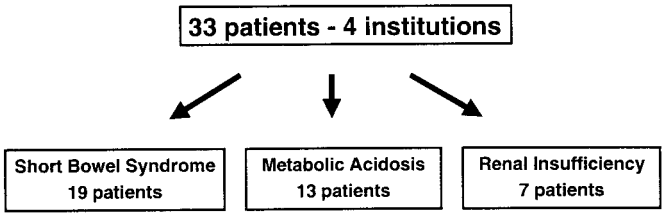


FIG. 1. Gastrointestinal patient population

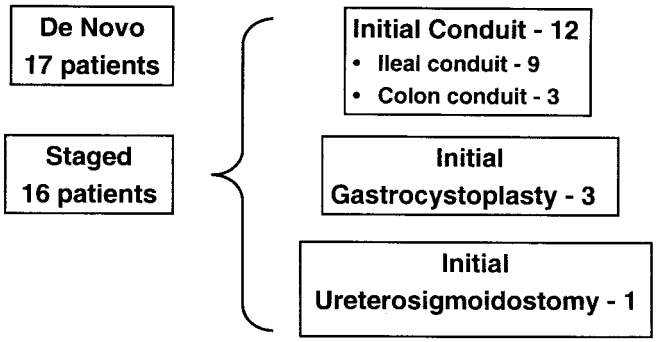


FIG. 2. Surgical sequences. *De Novo*, new construction

gastric segments of the composite reservoirs differed in terms of the harvesting technique among institutions. In 20 patients an 8 × 4 cm. rhomboid wedge was harvested from the gastric midbody, while in 3 an 8 × 12 cm. triangular flap was obtained from the midgastric body with a gastric strip extension along the greater curvature to serve as the efferent limb. The continence mechanisms were also slightly different in our population. In the majority of patients a tapered and reimplanted ileum was performed using the Mitrofanoff principle.[12] In 3 cases appendicovesicostomy was performed and in another 14 the gastric segment was used as the efferent limb. In 1 patient the gastric tube was reimplanted using the Mitrofanoff principle, and in the remaining 13 a tubularized and imbricated gastric strip from the extended gastric segment was performed by one of us.

Metabolic measurements included preoperative and postoperative serum electrolytes as well as serum bicarbonate and creatinine. In addition, serum pH was measured in 10 patients preoperatively and postoperatively. Serum gastrin was determined in 12 patients and urinary pH was followed postoperatively in 27. Surgical results and complications monitored postoperatively involved problems associated with the composite reservoir, gastrointestinal tract, stoma, ureters and subsequent surgery.

## RESULTS

The 33 patients who underwent gastrointestinal composite reservoir creation were followed a mean of 54 months postoperatively. Two patients were lost to followup and 1 died of metastatic disease. The table shows acid base parameters measured preoperatively and postoperatively. There was a significant normalization of serum chloride, bicarbonate and pH. Other metabolic parameters determined included serum gastrin and urinary pH, which were not abnormal at long-term followup (see table). In 3 cases temporarily elevated gastrin levels normalized at further followup, as reported previously.[10]

Renal function was normal in 26 patients. Long-term mean postoperative serum creatinine plus or minus standard deviation was 0.98 plus or minus 0.3 mg./dl. Renal insufficiency preexisted in 7 cases. Average preoperative creatinine in these compromised patients was 3.46 mg./dl. and average postoperative creatinine was 4.23 mg./dl., which was not significantly different. Two patients underwent subsequent renal transplantation and 3 required dialysis.

*Acid base parameters preoperatively and postoperatively, and serum gastrin and urinary pH postoperatively*

| | No. Pts. | Av. Preop. | Av. Postop. |
|---|---|---|---|
| Serum: | | | |
| Chloride (mEq./l.) | 28 | 106 | 102 ($p < 0.05$) |
| Bicarbonate (mEq./l.) | 30 | 23.3 | 25 ($p < 0.05$) |
| pH | 10 | 7.36 | 7.4 ($p < 0.05$) |
| Gastrin ± SD (pg./l.) | 12 | | 60.8 ± 33.5 |
| Urinary pH ± SD | 27 | | 5.96 ± 1.0 |

Postoperative complications involving the gastrointestinal tract, reservoir, stoma and ureters were noted during followup. Consequently 26 subsequent operations were required for these postoperative complications as well as for various unrelated indications (fig. 3). Reoperation was done on the stoma in 8 patients (24%), on the reservoir in 6 (18%), for the ureters in 4 (12%) and at the kidney or bowel and abdomen in 2 each (6%). Four of the 26 procedures were unrelated to composite reservoir construction. These patients included 2 who were previous candidates for renal transplantation, 1 with preexisting nephrolithiasis who required percutaneous nephrolithotripsy and 1 with cloacal exstrophy who received an ileal neovagina.

The 14 patients in whom a gastric tube served as the efferent limb of the continent composite reservoir had certain complications, including stomatitis, H2 blocker requirement, omeprazole and vitamin B12 in 2 each.

## DISCUSSION

The limitations of single segment urinary reservoir reconstruction have been well documented.[1,3] In 1993 Lockhart et al described the gastroileal pouch as an alternative continent urinary reservoir in patients with the short bowel syndrome and metabolic acidosis.[5] Since this initial report, they have observed short-term and long-term serum acid base changes associated with the composite urinary reservoir in adults.[8,13] Similar data have also been reported in children.[6,11] Furthermore, the metabolic influence may be altered depending on the size of the composite segments.[9] Our study combining the experience at several institutions supports the perception that long-term electrolyte neutrality is achieved with the composite reservoir.

Because multiple institutions participated in our series, there were subtle differences in surgical reconstruction. The primary difference was construction of the continence mechanism, which included ileovesicostomy, appendicovesicostomy or a gastric tube. A majority of continent mechanisms

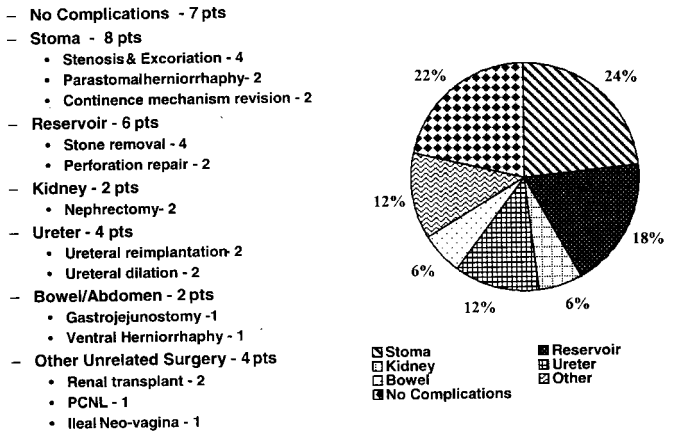


FIG. 3. Complications and subsequent surgery. *PCNL*, percutaneous nephrolithotripsy.