Long-Term Renal Functional Outcomes after Primary Gastrocystoplasty

Katherine C. Hubert,* Timothy Large, Jeffrey Leiser, Benjamin Judge, Konrad Szymanski, Benjamin Whittam, Martin Kaefer, Rosalia Misseri, Richard Rink and Mark P. Cain

From the Riley Hospital for Children, Indiana University School of Medicine, Indianapolis, Indiana

Purpose: We assessed long-term renal function, morbidities and mortality in 50 patients who had undergone primary gastrocystoplasty at our institution.

Materials and Methods: We retrospectively reviewed patients 21 years or younger who had undergone primary gastrocystoplasty between 1984 and 2004. Patients who underwent secondary gastrocystoplasty or primary composite augmentation or had cloacal exstrophy were excluded. Primary outcome was progression to end-stage renal disease. Secondary outcomes included mortality, bladder malignancy, hematuria-dysuria syndrome, electrolyte abnormalities and surgical revisions.

Results: Of 50 patients who had undergone gastrocystoplasty 35 met inclusion criteria. Median age was 9.4 years and 60% of the patients were male. Median followup was 19 years (IQR 11 to 25). Of the 35 patients 15 (43%) had normal preoperative estimated glomerular filtration rate and 5 (14%) had stage 2, 10 (29%) stage 3 and 5 (14%) stage 4 chronic kidney disease. Five of the 15 patients with stage 3 or 4 chronic kidney disease improved to normal estimated glomerular filtration rate, 1 remained with stage 3 disease and 9 progressed to end-stage renal disease. In 1 patient with normal estimated glomerular filtration rate end-stage renal disease developed following an episode of septic shock due to osteomyelitis. Seven patients in the cohort (20%) died, with 1 each dying of ventriculoperitoneal shunt infection, pneumonia, end-stage renal disease, complications of pregnancy and unknown cause, and 2 patients dying of septic shock due to urinary tract infection. There were no bladder malignancies. Hematuria-dysuria syndrome developed in 9 patients (24%). Eight patients (23%) underwent surgical revision.

Conclusions: The majority of patients had preserved or improved renal function after gastrocystoplasty. There were no deaths attributable to gastric augmentation and no bladder malignancies. Approximately a fourth of patients required surgical revision.

Key Words: follow-up studies, pediatrics, renal insufficiency, urologic surgical procedures

Abbreviations and Acronyms

CKD = chronic kidney disease

eGFR = estimated glomerular filtration rate

ESRD = end-stage renal disease

GFR = glomerular filtration rate

HDS = hematuria-dysuria syndrome

MDRD = modification of diet in renal disease

UTI = urinary tract infection

Accepted for publication December 22, 2014.

Study received institutional review board approval.

* Correspondence: Division of Pediatric Urology, Riley Outpatient Center, No. 4230, 705 Riley Hospital Dr., Indianapolis, Indiana 46202 (telephone: 216-269-7878; FAX: 317-274-7481; e-mail: kchubert@iupui.edu).

Use of a gastric segment for bladder augmentation in patients with a small or poorly compliant bladder was initially described for those with renal insufficiency and acidosis or short bowel syndrome.[1] Gastric mucosa not only acts as a barrier to reabsorption of urinary salts such as ammonium

0022-5347/15/1936-2079/0
THE JOURNAL OF UROLOGY®

http://dx.doi.org/10.1016/j.juro.2014.12.088
Vol. 193, 2079-2085, June 2015
Printed in U.S.A.

and chloride, but also excretes chloride. These properties made gastric mucosa an attractive substrate for bladder reconstruction in patients with impaired renal function and limited reserve for excretion of these salts.[2] This approach was thought to be advantageous in patients with cloacal exstrophy with a deficiency of large and small bowel to avoid decreasing the absorptive intestinal surface.[1] Subsequent series using gastrocystoplasty in patients with spinal dysraphism, bladder exstrophy, posterior urethral valves, persistent urogenital sinus and ectopic ureters have also been described. Long-term followup studies have focused on postoperative complications with the use of gastric segments, including bladder malignancy, stones, hematuria-dysuria syndrome and metabolic alkalosis.[3–6]

Several series have examined postoperative renal function, with mean followup ranging from 2.9 to 4.4 years.[7,8] However, there are limited data on the long-term impact of gastrocystoplasty on renal function. We assessed long-term renal function in patients who had undergone primary gastrocystoplasty. We hypothesized that primary gastrocystoplasty does not prevent progression to renal failure in the postoperative period. We also report the long-term mortality and morbidities associated with this procedure, including bladder malignancy, HDS, electrolyte abnormalities and surgical revisions.

MATERIALS AND METHODS

We performed a retrospective chart review of all patients who underwent primary gastrocystoplasty at our institution from January 1984 to December 2004. Patients who were older than 21 years at surgery or had cloacal exstrophy were excluded. Cloacal exstrophy cases were excluded because of associated short gut syndrome and/or renal insufficiency, which may affect long-term outcomes. We also excluded patients who underwent secondary gastrocystoplasty, defined as bladder augmentation with a gastric segment following primary bladder augmentation with a nongastric bowel segment. Finally, we excluded those who underwent primary composite augmentation, defined as bladder augmentation with a gastric and a nongastric bowel segment concurrently. We reviewed patient demographics, etiology of neuropathic bladder, renal function at baseline and followup, details of surgical procedures, causes of death and postoperative complications such as bladder malignancy, HDS, urolithiasis and electrolyte abnormalities. Renal function was determined by calculating eGFR at baseline and at the last available date during clinical followup, using age appropriate formulas. The bedside Schwartz formula for eGFR was used in patients younger than 18 years.[9] This formula approximates eGFR in children from plasma creatinine and body length, as GFR (ml/min/1.73 m^2) = (0.413 × height in cm/creatinine in mg/dl). The 4-variable MDRD formula, which includes demographic and serum variables, was used in patients 18 years or older, as GFR (ml/min/1.73 m^2) = 175 × (serum creatinine)$^{-1.154}$ × (age)$^{-0.203}$ × 0.742 (if female) × 1.212 (if black race).[10]

The primary outcome of interest was progression to end-stage renal disease, defined as the need for chronic dialysis and/or renal transplantation. Chronic kidney disease was defined according to the criteria proposed by the National Kidney Foundation, in which stage 1 is described as kidney damage with a normal or increased GFR (90 ml/min/1.73 m^2 or greater), stage 2 as kidney damage with a mildly decreased GFR (60 to 89), stage 3 as moderately decreased GFR (30 to 59), stage 4 as severely decreased GFR (15 to 29) and stage 5 as kidney failure (less than 15, or requiring dialysis).[11] Secondary outcomes included death, bladder malignancy, HDS, urolithiasis and electrolyte abnormalities, as well as surgical revision. Deaths were verified using the Social Security Death Index. Causes of death were identified by review of the medical record and, if needed, the death certificate. The institutional review board approved the study.

RESULTS

Of the 50 patients who had undergone gastrocystoplasty 35 met inclusion criteria. Reasons for exclusion from the study are outlined in figure 1. Of 5 patients excluded for undergoing nonprimary gastrocystoplasty initial composite augmentation with ileum and stomach had been performed in 1, primary ileal augmentation in 3 and primary sigmoid augmentation in 1. Of 7 patients excluded for cloacal exstrophy 3 had also undergone nonprimary gastrocystoplasty, consisting of composite augmentation of ileum/colon in 1, composite augmentation of ileum/stomach in 1 and primary ileal augmentation in 1.

Of the patients 60% were male, and median age at surgery was 9.4 years (IQR 6.1 to 13.8). The primary etiologies of abnormal bladder function, indications for use of a gastric segment for bladder augmentation and baseline renal functional status are outlined in the Appendix. Eight patients with normal

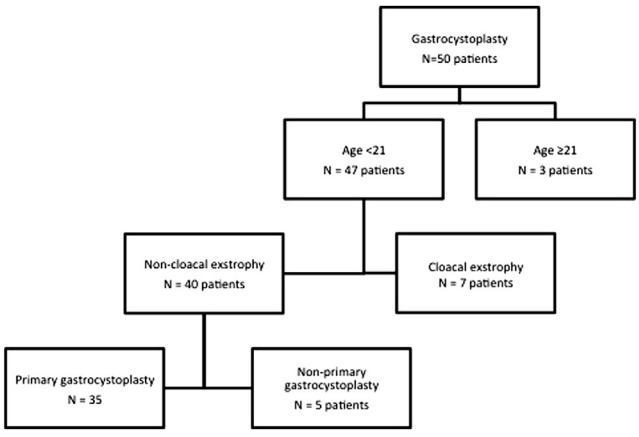

Figure 1. Selection process of primary gastrocystoplasty cases