What is the Need for Additional Bladder Surgery After Bladder Augmentation in Childhood?

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Purpose: Bladder augmentation has revolutionized the care of children with a neuropathic bladder but it remains a major surgical procedure. However, the need for subsequent bladder surgery has not been well defined in a large series with long-term followup.

Materials and Methods: We retrospectively reviewed the records of the first 500 bladder augmentations performed from 1978 to 2003 at our institution. Charts were reviewed for complications requiring additional surgery, including malignancy, bladder perforation, repeat augmentation, bowel obstruction and bladder calculi. Mean and median followup was 13.3 years.

Results: Complications occurred in 169 patients (34%) resulting in a total of 254 surgeries. The cumulative risk of further surgery at the bladder level was 0.04 operations per patient per year of augmentation. Three patients (0.6%) had transitional cell carcinoma, of whom all presented with metastatic disease and died. Bladder perforation occurred in 43 patients (8.6%) with a total of 53 events. Of the patients 16 (3.2%) required laparotomy for bowel obstruction and 47 (9.4%) required repeat augmentation. Bladder stones were treated in 75 patients (15%), who required a total of 125 surgeries.

Conclusions: Bladder augmentation provides immeasurable improvements in quality of life but it requires lifelong dedication from the patient, family and health care providers. While the requirements for additional surgery are not trivial, 66% of our patients have not required any further surgery in the augmented bladder.

Key Words: bladder, urinary diversion, complications, calculi, neoplasms

Bladder augmentation has proved to be an invaluable tool in the pediatric urology armamentarium but it is a major surgical procedure with significant potential complications. Our institution shows the largest experience with intestinocystoplasty in children. We reviewed our cohort for complications that required augmented bladder revision. We believe that bladder augmentation represents an excellent means of renal protection and improvements in quality of life but the true incidence of complications must be realized.

We specifically examined the most common and serious surgical complications at the bladder level, including malignancy, bladder perforation, re-augmentation, bowel obstruction and bladder calculi. This summary is of significant clinical value since it provides data on surgical complications in what is to our knowledge the largest reported series.

METHODS

We retrospectively reviewed the charts of the first 500 bladder augmentations performed at our institution from 1978 to 2003. The 500 patients were identified through a previously compiled database and complications were identified through operative records. This information was cross-referenced with other reviews of groups at our instituion.[1–3] Information was compiled with FileMaker® Pro 7.0, version 2. The statistics used were the chi-square test or OR with significance considered at $p < 0.05$ or the 95% CI.

RESULTS

At our institution the 500th bladder augmentation was performed in 2003. These augmentations were performed in a 25-year period by 8 surgeons. Followup was a minimum of 2 years (mean and median 13.3). Average age at augmentation was 11.8 years in the 258 males and 242 females. The most common primary disease was myelomeningocele in 272 cases (54.4%), while nonneuropathic causes occurred in 107 (21.4%) (table 1).

Of the 500 augmentations 297 were performed with ileum (table 2). Of the patients 207 (41%) underwent bladder neck surgery at augmentation and 46 underwent bladder neck surgery before augmentation. Catheterizable channels were created in 239 patients (46.8%), including 185 at augmentation.

Complications at the bladder level that resulted in surgery developed in 169 patients (34%) for a total of 254 surgeries (fig. 1). The mean number of operations in those patients with a complication at the bladder level was 1.5 and the incidence was 0.04 operations per patient per year of augmentation. There were 4 deaths (0.8 %) due to malignancy (3) and bladder perforation (1).

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TABLE 1. *Diagnoses in 500 patients in our cohort*

Diagnosis	No. Augmentations
Myelomeningocele:	272
Sacral agenesis	25
Other spinal dysraphism	39
Spinal cord injury	17
Spinal cord tumor	6
Bladder exstrophy + epispadias	42
Cloacal exstrophy	12
Posterior urethral valves	21
Imperforate anus	12
Nonneurogenic neurogenic bladder	20
Cloaca/urogenital sinus	5
Miscellaneous	29

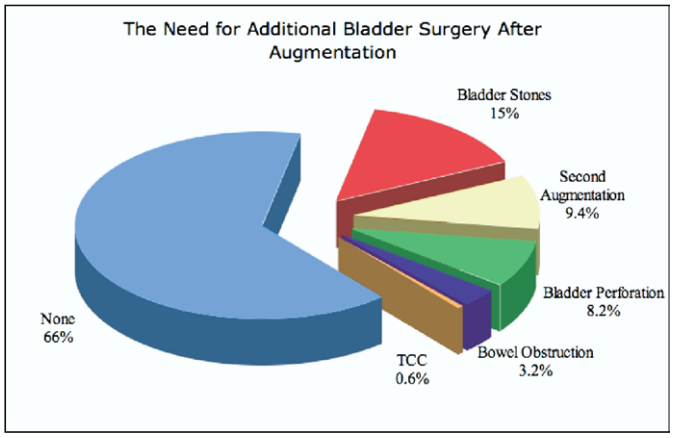

FIG. 1. Number and distribution of complications. Of our cohort 66% did not require any further surgery at bladder level. *TCC*, transitional cell carcinoma.

Malignancy

Malignancies were detected in 3 patients (0.6%) in our cohort and they have previously been reported.[4] All patients had metastatic transitional cell carcinoma and died of disease. Mean patient age was 37 years (37, 30 and 45) and mean time from augmentation was 19 years (17, 21 and 21, respectively). Two patients presented with gross hematuria and 1 presented during laparotomy for stomal revision. Two augmentations were constructed with ileocecal segments and the third was created with sigmoid colon.

Spontaneous Augmentation Perforation

Bladder perforation was diagnosed in 43 patients (8.6%). Nine patients had 2 perforations each and 1 patient had 3 for a total of 54 events. We calculated the incidence at 0.0066 perforations per year of augmentation. One death occurred elsewhere secondary to delayed diagnosis and overwhelming sepsis. Laparotomy and open repair were performed in 47 cases (87%) and conservative management was successful in the remaining 7 (13%).

Mean time from surgery to perforation was 46 months (median 35). A total of 14 perforations (33%) occurred within 2 years of surgery, 15 (35%) occurred between 2 to 6 years postoperatively and 14 (33%) occurred more than 6 years after augmentation. Figure 2 shows patient age at bladder perforation.

There was a significantly increased risk of perforation with bladder neck surgery vs no bladder neck surgery (29 of 105 cases or 28% vs 13 of 304 or 4.3%, $p < 0.05$). The lowest incidence was seen if the patient received a bladder neck sling (1 of 53 or 1.9%). Again, this was a statistically significant difference ($p < 0.05$, fig. 3).

An increased risk of perforation was also seen with the use of sigmoid colon as intestinocystoplasty with a prevalence of 27% (16 of 84 cases). Perforations occurred in 23 of the 297 ileal augmentations (5%), which was not significantly different from the rate in gastric (2 of 44 or 5%) or cecal (2 of 38 or 4%) cases.

The calculated OR showed in a 2.7-fold decreased risk of perforation with the use of catheterizable channels, representing a significant difference (OR 2.7, 95% CI 1.0 to 5.8). Of 239 patients with a Monti or Mitrofanoff channel 14 (5.8%) had perforation, while those without a catheterizable channel were at 11% risk (29 of 261).

Bowel Obstruction

Of the patients 16 (3.2%) required laparotomy for bowel obstruction. Mean time to obstruction from surgery was 51 months. Six laparotomies occurred within 2 months of the original surgery, 1 occurred between 2 and 12 months, and 9 occurred more than 12 months postoperatively.

The original segment used for augmentation was ileum in 6 of 16 cases (38%), sigmoid in 3 (19%), cecum in 2 (13%) and stomach in 5 (31%). Calculating OR results showed that gastrocystoplasty was 6 times more likely to result in laparotomy for bowel obstruction than ileocystoplasty (OR 6.06,

TABLE 2. *Original tissue used for augmentation in our cohort*

Original Segment Used	No. Pts
Ileum	297
Sigmoid colon	85
Ileal-sigmoid composite	8
Gastric	38
Composite ileal or sigmoid gastric	7
Cecal/ileocecal	46
Ureter	8
Ureter + ileum	3
Unknown	8

No information was available on 8 patients (1.6%).

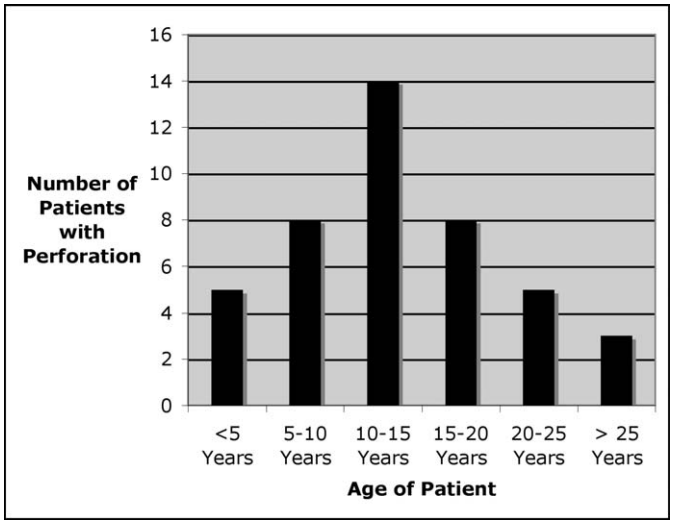

FIG. 2. Patient age at bladder perforation. Highest risk age group was 10 to 15 years, which may have been related to increased catheterization independence.