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Bladder capacity as a predictor of voided continence after failed exstrophy closure☆

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Abstract *Objective:* To evaluate potential predictors of voided continence among bladder exstrophy patients with a history of a failed closure.
Patients and methods: The authors reviewed all patients who underwent a bladder neck reconstruction (BNR) with a history of one or more failed exstrophy closures between 1979 and 2007. The following data were collected for each patient: number of failures, site of surgery, mode of failure, presence of osteotomy, bladder capacity, need for additional procedures, and continence status.
Results: Among patients who underwent successful reclosure following one or more failed closures, 52 patients underwent BNR, and 24 (46%) were continent at last follow-up. Bladder capacity was the only variable predictive of voided continence. The median bladder capacity at the time of BNR differed between those who achieved continence (100 mL) and those who did not (65 mL) ($p = 0.005$). ROC analysis showed an optimal pre-BNR bladder capacity cutoff for predicting future BNR success of between 80 and 100 mL.
Conclusion: As previously shown in patients with successful primary closure of exstrophy, these data suggest that bladder capacity also has predictive value in the success of BNR after failed exstrophy closure.

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Introduction

Regardless of which type of primary repair is used, successful closure of bladder exstrophy is a critical determinant of long-term urinary continence. When applying the techniques of the modern staged repair of exstrophy, bladder neck reconstruction (BNR) results in voided urinary continence in 70–75% of patients after successful primary closure [1,2]. Children with one or more failed closures represent an extremely challenging subset of patients with poorer outcomes. The consequences of failed initial closure include increased collagen and scar formation [3,4], decreased bladder growth [5], decreased capacity [6], and increased rates of urinary incontinence [7]. Dryness can be achieved in patients with failed initial closure, but often at the expense of intermittent urethral catheterization or continent urinary diversion [8].

Voided continence may be achieved in some patients by means of BNR. Determining which children are candidates for BNR can be difficult. Among children who have undergone successful primary closure with the modern staged repair of exstrophy, capacity represents the best way to determine which bladders are suitable for repair [9]. Despite this, a significant number of children who undergo BNR after failed closure remain incontinent and require further major surgical procedures to attain dryness. The authors aimed to identify variables that can reliably predict the success of BNR following prior failed exstrophy closure.

Materials and methods

After approval by the institutional review board, all patients with classical bladder exstrophy born between 1979 and 2007 who underwent a BNR with a history of one or more failed closures were identified from an institutionally approved weekly updated exstrophy database. Criteria for inclusion were diagnosis of classical bladder exstrophy, a history of one or more failed closures, and a BNR performed with the purpose of achieving voided continence. At the authors' institution, all patients underwent a Modified Young–Dees–Leadbetter BNR [10]. Patients with cloacal exstrophy, exstrophy variants, continence procedures (i.e. augmentation cystoplasty, artificial urinary sphincter, etc.) performed prior to BNR, or a BNR performed in conjunction with another continence procedure were excluded from the analysis. The medical records of all patients were retrospectively reviewed for the following information: gender, age at each surgery, duration of time between surgeries, site of surgery, number of failures, mode of failure, whether or not an osteotomy was performed with initial and successful reclosures, bladder capacity at the time of BNR, and continence status at last follow-up. Only patients with a minimum follow-up of 6 months were included in this study.

At our institution, bladder capacity was obtained prior to BNR by gravity cystogram under anesthesia by instillation of normal saline at 30 cm of water pressure into the bladder using a catheter with an overinflated balloon to prevent leakage. All patients undergo a plain film cystogram when the bladder is determined to be at maximum capacity. If vesicoureteral reflux is demonstrated on cystogram, 1 mL for each grade of reflux is subtracted from the total capacity (i.e. 6 mL subtracted in patients with bilateral grade 3 reflux). If reflux was noted to be dilating or high grade, a second radiograph is performed after the bladder is drained. No patient in this study had evidence of upper tract obstruction.

Continence was defined as volitional voiding through the urethra, night-time dryness, and a >3-h interval of dryness during the day. At the time of follow-up, patients were evaluated for continence and length of dry interval.

Subjects were placed into one of two groups for comparison. Based on data from last follow-up, patients either had a successful BNR (voiding and continent) or an unsuccessful BNR (incontinent, requires intermittent urethral catheterization, or underwent subsequent continent urinary diversion). Univariate analyses of categorical and continuous variables were obtained by the Fisher exact test and the Student t test, respectively. Multivariate logistic regression analysis was also performed. Sensitivities and specificities were calculated for statistically relevant predictors of BNR success found through variate analysis and the values were plotted on a receiver operating characteristics (ROC) curve. All statistical analyses were performed with Microsoft Excel 2007 and Stata IC 12. A p value < 0.05 was considered statistically significant.

Results

A total of 52 patients (44 male/8 female) with a history of failed primary closure who underwent a BNR with intention of voided urethral continence were identified and were included in the analysis. Follow-up data were available on all 52 patients with a median follow-up of 13 years (range 6 months–26 years) after time of BNR. Forty-five (87%) were referred after one or more failed primary closures, and seven (13%) represented failed primary closures from the authors' institution.

The median age at the time of initial failed closure was 2 days (range 0 days–12 months). Prior to successful reclosure, 39 (75%) patients had one, 11 (21%) patients had two, and two (4%) patients had three prior failed closures. Mode of initial failure included dehiscence in 28 (54%) and prolapse in 24 (46%) subjects. Eight patients (15%) at a median age of 3 days (range 0 days–4 months) had an osteotomy with initial failed closure. The remaining 44 (85%) were closed without osteotomy at a median age of 2 days (range 0 days–12 months). At the time of initial failed closure, 29 patients were immobilized with spica casts or mummy wraps, 15 patients were placed into modified Bryant's traction, four patients had external fixation with modified Buck's traction (after osteotomy), and four patients had no postoperative immobilization or traction.

All patients underwent successful reclosure at a median age of 17 months (range 7 days–70 months). Forty (77%) patients underwent successful reclosure at the authors' institution, and 12 (23%) patients underwent successful reclosure at an outside institution before they were referred. Median time between initial failed closure and successful reclosure was 16 months (range 6 days–59 months). Osteotomy was not performed in eight (15%) patients at the time of successful reclosure (5 of these