Complete Primary Repair of Bladder Exstrophy Is Associated With Detrusor Underactivity Type of Neurogenic Bladder

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OBJECTIVE To test the hypothesis that complete primary repair of bladder exstrophy (CPRE) is associated with detrusor underactivity. For this purpose, we review (1) our experience, (2) the results of the published literature as it pertains to bladder function, and (3) the known anatomic basis on which the mechanism of the observed outcome can be understood.

METHODS The medical records of all patients who underwent CPRE by the author between 2004 and 2010 were reviewed. Attention was focused on the clinical, imaging, and urodynamic findings.

RESULTS Four men and 2 women underwent CPRE. Follow-up ranges from 2 to 8 years. Four underwent bilateral ureteral reimplantation combined with bladder neck repair in 3. Detrusor activity (or overactivity) was not recorded in the 5 patients who underwent urodynamic studies. Four patients achieved short periods of urinary continence. The percent predicted bladder capacity, adjusted for age, ranged from 25 to 70, with a median of 60. Of the 68 publications on CPRE since 1999, none reports the presence of detrusor activity. A description of the pelvic plexus anatomy by Walsh and Donker provides a basis for the mechanism of injury resulting in the previously mentioned results: (1) complete penile disassembly eliminates the distal fixation point of the bladder-urethral plate, (2) the subsequent dissection and mobilization result in shearing injury to the microscopic pelvic plexus branches to the bladder, external sphincter, and prostatic urethra.

CONCLUSION CPRE results in disruption of the branches of the pelvic plexus and a neurogenic bladder (detrussor underactivity). UROLOGY 83: 1139–1144, 2014. © 2014 Elsevier Inc.

The surgical treatment of bladder exstrophy in the newborn continues to evolve. The complete primary repair of bladder exstrophy (CPRE) procedure first described in 1998 by Grady and Mitchell[1,2] represented an alternative to the time tested staged repair described by Jeffs and Cendron and refined by Mathews and Gearhart[3] over the last 3 decades. The stated rationale for abandoning the staged repair was to reduce the number of procedures required to attain the objectives of "urinary continence and allow voiding function".[1] Other notable approaches, which have been developed and described in the literature have not gained popularity in North America but deserve careful study.[4-6] In this communication, we focus on describing the effects of CPRE on bladder function and providing an anatomic and pathophysiologic basis for the observed outcomes.

PATIENTS AND METHODS

The medical records of all the patients who underwent CPRE by the author as primary surgeon were reviewed after obtaining institutional review board approval.

During CPRE, attention was directed at the important steps of the procedure, which consist of extensive dissection of the perineum with deep incisions of the intersympheseal band and pelvic diaphragm fibers on either side of the prostatic urethral plate in men.[7] This exposure becomes feasible because of penile disassembly, which provides direct access to the pelvic diaphragm (Fig. 1). The adequacy of this dissection is visually appreciated by the resultant cephalad and posterior movement of the bladder plate − urethral complex into the pelvis. The bladder and urethra are then tubularized followed by approximation of the corpora in the midline on top of the urethra, which assumes a hypospadiac position. In girls, the bifid clitoris is already "disassembled", and therefore, dissection is directed at incising the pelvic diaphragm fibers on either side of the vagina − urethral plate complex.[7] Because of the resulting cephalad movement of the bladder-urethral complex into the pelvis, the urethra becomes hypospadiac by default. An orthopedic surgeon with bladder exstrophy experience performed at the beginning of the procedure bilateral anterior osteotomies when manual approximation of the symphysis was judged to be insufficient after induction of anesthesia.

For the urodynamic studies to be described, catheters were placed in the bladder and rectum under anesthesia at diagnostic

Financial Disclosure: *The authors declare that they have no relevant financial interests.*

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Submitted: September 4, 2013, accepted (with revisions): November 9, 2013

http://dx.doi.org/10.1016/j.urology.2013.11.010

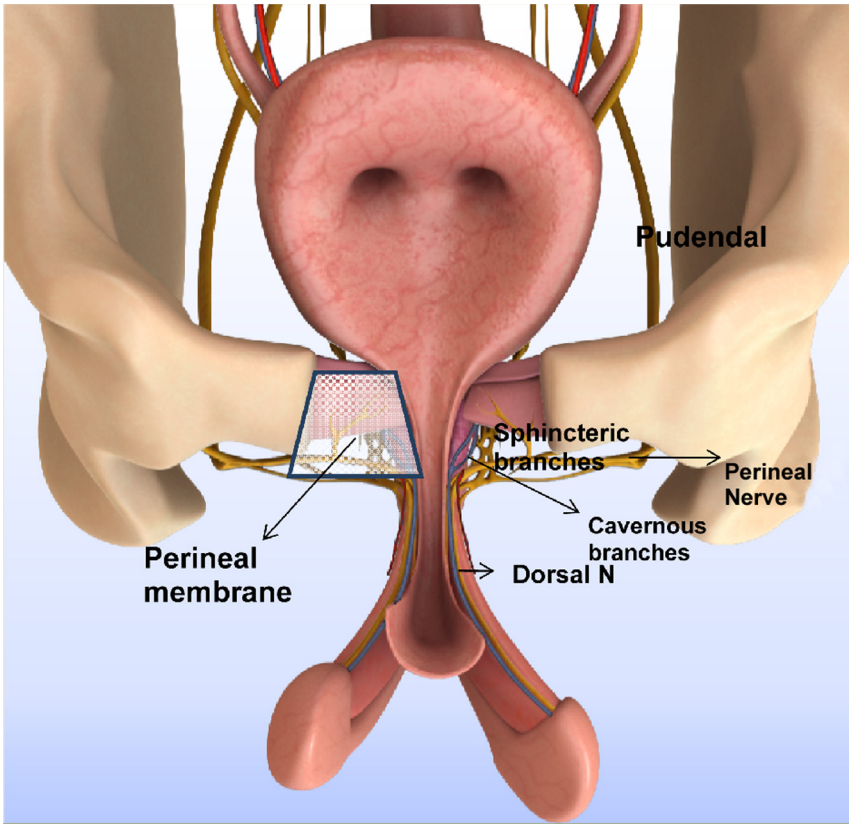

Figure 1. Surgeon's view of bladder exstrophy during complete primary repair of bladder exstrophy; the pelvic diaphragm separates the pelvic sphincter mechanism from the bulbospongiosus, superficial transverse perineal muscle, and associated neurovascular structures that pierce it.

cystoscopy. The latter was indicated for evaluation of bladder and bladder neck anatomy, the presence of vesicoureteral refux (VUR; in conjunction with positional instillation cystography), or before a planned bladder neck injection with Deflux to provide outlet resistance. After initial cystoscopy, a 7F urodynamic air-charged catheter is inserted in the bladder and an abdominal pressure catheter in the rectum just past the external sphincter (T-DOC Company, Wilmington, DE; www.tdocllc.com). Surface patch electrodes are then applied just superior to the perineal body on either side of the midline. The anesthetic protocol was switched to one used for detection of evoked potentials during spinal surgery and consisted of total intravenous anesthesia.[8] After calibration of the instrument, bladders were filled at a rate equal to 10% of expected capacity for age with methylene blue spiked, room temperature mixture of normal saline and contrast. A Medtronic Duet multiport (version 9.0; www.medtronic.com) was used to record peak bladder pressure at the first leak, bladder contractions with or without a leak or voiding, bladder wall compliance, and electromyography amplitude. The presence of VUR and the appearance of the bladder neck were observed under fluoroscopy. Capacity in the face of VUR was defined as the total volume infused before passive fluid leakage. The volume at which VUR was detected was recorded separately. A contraction was defined as a spike over baseline bladder pressure with or without voiding.

The known anatomic literature of bladder exstrophy was reviewed with the intent of creating a 3-dimensional simplified medical illustration of the pertinent structures with specific attention to the pelvic neurovascular bundle (Fig. 2).[9,10]

RESULTS

Clinical

A total of 6 patients (4 boys and 2 girls) underwent CPRE (3 each with and without osteotomy). Follow-up ranges from 2 to 8 years, with a median of 5. Four patients have achieved a degree of urinary continence (a minimum of 1 hour dry interval during the day). Three patients void by abdominal straining, and one has a catheterizable appendiceal channel. In 3 patients who could "void" on command, a uroflow followed by a bladder scan was obtained on at least 2 occasions: all had a flat uroflow profile (Fig. 3A) and a postvoid residual ranging from 30% to 50% of voided volume. The frequency of the febrile urinary tract infections (2-12/year/patient) decreased as the children acquired the ability to better empty the bladder by abdominal straining (Table 1).

Imaging

All had initial bilateral VUR (hi grade in 5 units). Frequent febrile urinary tract infections prompted bilateral ureteral reimplantation in 4 combined with bladder neck repair (BNR) in 3. VUR resolved in all but 3 units (grade 1 in 2). Hydrouretronephrosis of grade 3, without VUR, persists in 1 of 12 units at risk. The bladders appear smooth on cystography (Fig. 3B).