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Classic bladder exstrophy: patient and operating theatre preparation for primary bladder closure

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Bladder exstrophy is a rare congenital disorder involving the musculoskeletal system and the genitourinary tracts, and can range from balanic epispadias to classic exstrophy. Primary closure is a complex procedure requiring several different surgical modalities to ensure a successful outcome for the patient. Intraoperative management includes appropriate draping, instrumentation, adapting to possible anatomic variations.

Keywords: operating theatre, sterile draping, bladder exstrophy, orthopaedics, paediatric urology

Introduction

The exstrophy-epispadias complex (EEC) is a congenital disorder that involves the musculoskeletal system, genitourinary tracts, and sometimes the intestinal tract. It is a rare spectrum disorder with phenotypes widely ranging from balanic epispadias to cloacal exstrophy.[1] The prevalence of classic bladder exstrophy is around 3.3 per 100 000 live births and is twice as common in males.[2]

Initial bladder closure is performed in infancy, depending on the patient's weight and the size of the bladder plate. The procedure involves a multispecialty approach that includes anaesthesia/pain management, orthopaedics, and genitourinary procedures for success. The goal of initial reconstruction is to place the bladder and bladder neck deep in the pelvis, with osteotomies performed to approximate the pelvic ring and reduce tension on the abdominal wall reconstruction. The use of tunnelled epidural catheters permits postoperative pain management without the need for significant patient movement. The specifics of the orthopaedic and urologic surgical technique of bladder exstrophy closure, as well as an in-depth review of the anaesthetic considerations, are detailed in separate manuscripts in this special edition of the journal.

As outlined in the separate surgical manuscripts, the osteotomy and bladder closure approaches favoured by the surgeons from our institution include bilateral innominate and iliac osteotomies (anterior approach) and the modern staged repair of exstrophy (MSRE). Herein we discuss the routine patient and operating theatre preparation that promotes patient safety and facilitates surgical closure. Table I summarises the important considerations, which are described in detail below. Signed, informed consent was obtained for all patient photography contained in this manuscript.

Patient and procedure considerations

The initial closure of the bladder is a complex operation that can take up to eight hours to complete. Moreover, since this procedure is typically performed in an infant or young child, concerns for temperature regulation and fluid dynamics while under anaesthesia are additional challenges.

Table I: Highlights of bladder exstrophy operating theatre care for bladder closure

1. The entire operating theatre must be latex-free. This minimises the risk of an acquired latex allergy.
2. The exstrophy patient is prepped and draped circumferentially from their nipple line to their toes.
3. Care should be taken to ensure that no prep solution pools under the patient during the patient's sterile prep. Due to the procedure length, patient positioning and padding need meticulous attention.
4. An underbody patient warmer and warmed operative irrigation fluids are essential to maintain normothermia.
5. Paediatric orthopaedic and paediatric surgery/urology instruments will be required.

Access to the lower body requires that patients be prepped and draped circumferentially from the nipple line to the toes (Figures 1 and 3). Both the orthopaedic and urology teams use this same surgical field setup. Factors relating to the patient's position include extensive prepping, prevention of prep solutions pooling under the patient, risking skin injury, placement of the electrocautery grounding pad in a clean and dry location, and access for fluoroscopy of the pelvis. Due to the length of the operative procedure, padding of the bony prominences, such as the sacrum, heels, and scapula, is crucial.

In addition to the standard operating table's routine mattress, an additional gel mattress cover or thick foam padding, such as a Geo-Matt therapeutic cushion (Span America Innovative Solutions, Greenville, South Carolina, United States) (Figure 2), should be placed on top of the routine mattress so there is extra padding under the entire child, even the areas prepped into the surgical field. This helps prevent operating theatre (OT)-related pressure injuries, which is important given the long duration of this procedure.

An underbody air warmer helps regulate the patient's temperature, as shown in Figure 1. This air warmer is also placed under the sterile drapes like the extra padding described above. Ideally, the type selected should extend towards the end of the bed to provide additional heating to the patient. Warmed fluids are critical to prevent unnecessary cooling. Specifically, all fluids on the surgical

Figure 1: Operating theatre bed preparation

Figure 2: Geo-matt and gel positioner

field should be warmed to a temperature no more than 104 degrees Fahrenheit or 40 degrees Celsius; a higher temperature would risk patient injury.

It is important to use absorbent pads or other absorbent material during the prep and drape procedure to ensure there is no pooling of betadine under the patient. The electrocautery pad should be placed on the upper back or between the scapulae in a dry location. Select the smallest pad allowed depending on the patient's weight, using caution not to interfere with the epidural line that will be taped in the same area. If available, a half screen or ether screen can be used to tent up the drapes over the patient's face, giving the anaesthesia provider better access to the patient while protecting the patient's face during the procedure.

Figure 1 shows the operating theatre bed with a Geo-Matt therapeutic cushion under the impervious bed cover. The underbody patient warmer is off the top of the bed and secured to the top of the table. The foot of the bed is raised, and the head of the bed has been removed.

Geo-Matt therapeutic cushion (Span America Innovative Solutions, Greenville, South Carolina, United States) or a gel-filled positioner should be placed under the patient and above the standard operating mattress to prevent OT-acquired pressure injuries (Figure 2).

Figure 3 shows a fully prepped and draped exstrophy patient. The lower extremity sterile towels and sterile gauze are important because, after pubic closure, penetrating towel clips are used to keep the legs adducted. Note that an ether screen holds the drapes

Figure 3: Prepped and draped bladder exstrophy patient

up so the anaesthetists can easily access the patient's upper body. Note that no intravenous (IV) lines, anaesthesia monitoring equipment, or cautery grounding pads are below the drape; these must all be on the upper extremities or torso.

Instruments, drapes, and other supplies

Orthopaedics and urology will be involved at various points in the case. Therefore, instrumentation specific to both specialities, including an external fixation system, will be required. Ideally, two instrument tables, one for each speciality, can be used. Nevertheless, one table can suffice if space constraints exist since both procedures are considered sterile.

Medications, haemostatic agents, and other agents that should be available for the procedure include 1 : 200 000 topical epinephrine for haemostasis and iohexol radiographic contrast for ureteral stent placement. Allograft cadaveric tissue, such as the regenerative tissue matrix AlloDerm (LifeCell Corporation, an AbbVie company, Branchburg, New Jersey, United States), and a fibrin hemostatic agent, such as Tisseel (Baxter Corporation, Deerfield, Illinois, United States), may be helpful, if available. The orthopaedic surgeon will usually use autografts taken from the osteotomy sites for their procedures, depending on the quality of the patient's bone.

The instrument set for the orthopaedic table will need to include Metzenbaum scissors, Cobb and Freer elevators, two small blunt Weitlaner retractors, a small blunt Hohmann retractor, short and longtoothed forceps, a small to medium mallet, and a range of osteotomes from small to medium width (Figure 4). A small drill system will be needed for a small sagittal saw and K-wires. Typically, a small external pelvic fixation system will have 4.0 × 120 mm long pins, T-handles, and 2.5 mm threaded K-wires, but if the patient is older, they may require larger pins. It is important to note that once pins are selected, at least six (three for each side) will be necessary. If a separate orthopaedic table is utilised, it needs to remain sterile until the patient leaves the room in the event that one of the pins becomes dislodged and needs to be replaced. The urology table will have a basic paediatric surgical set with the addition of so-called "gooseneck" forceps, also known as Gray Cystic Duct forceps. A

Figure 4: Orthopaedic back table with orthopaedic instruments, small drill, and implants; a basic hand-held drill may be substituted for a powered one

Figure 5: Paediatric urology/surgery back table setup including a paediatric basic set; this includes female urethral sounds and skin hooks of varying widths

Figure 6: Complete back table with both orthopaedic and urology instrument sets, a fluid warmer, and instruments; also shown are draping materials with a separate small mobile table used at the very beginning of the case

fluid warmer is also ideal to keep irrigating fluids warm to help the patient maintain a normal temperature. Please see Figures 5 and 6.

At the end of the case, the patient will have a suprapubic tube, bilateral ureteral stents, and, in some cases, a urethral stent. The suprapubic tube is typically a 10 Fr silicone Malecot catheter or a similar drainage tube, and the ureteral stents will range from 3.5 to 8 Fr. Soft and flexible catheters are important to prevent skin breakdown around the suprapubic site. The entire operative field should be latex-free. Patients with EEC undergo numerous urological procedures over their lifetime and have a high risk of developing a latex allergy.[3]

Choice of operating theatre bed

A regular OT bed with the head extension removed works well for this procedure. The bed pillar will need to be out of the way of the fluoroscopy machine; therefore, moving the patient down towards the foot of the bed is helpful. If the patient has a delayed closure and is thus larger, the bed may be extended by putting the headpiece at the foot of the bed or using a flat Jackson table. Traction supplies will be utilised at the end of the procedure, as the child will be in skin traction with 1–2 lb weights for each leg. The patient will also require a bed in the paediatric intensive care unit as they remain intubated for the night after the procedure.

Intraoperative draping technique

The draping technique is designed to accommodate a bladder exstrophy closure with anterior pelvic osteotomies. The anterior approach allows the patient to remain supine for the entire procedure; prep and draping only occur once, and there is less intraoperative bleeding. Supplies needed for the draping procedure include absorbent pads, two split drapes, one three-quarter drape, sterile towels, 4" cling wrap, Ioban antimicrobial incise drape (3M Corporation, Minneapolis, Minnesota, United States) or a highly adhesive alternative clear drape, and a betadine prep kit that includes scrub and paint. The patient will be prepped circumferentially from the nipple line to the toes, and this is ideally done by two people.

The infant will be positioned supine on an absorbent pad at the foot of the bed. The arms are often slightly flexed and abducted laterally to give the anaesthesia provider access to the IV and other lines. The patient is scrubbed and prepped circumferentially from the nipple line to their toes with an assistant to help pick the patient up by the ankles to allow the person prepping access to the posterior aspect of the body. The patient is then lowered on the absorbent pad, and the excess anterior prep is blotted with a towel. Up to this point, nothing has become sterile. Next, using sterile gloves, the patient is painted with 10% betadine from the nipple line to their toes in the same manner as the prep. The absorbent pads the patient was resting on are removed and replaced with a three-quarter sterile drape for the patient to rest on while the team is gowned and gloved. This prevents the pooling of betadine under the patient and allows the prep to dry completely.

A sterile blue towel is then placed around the child just below the nipple line and secured with a towel clip at the midline. If the child is too large for one towel, two towels, one posterior and one anterior, may be secured on each side by a towel clip. The towel offers skin protection and a place to stick the sticky drape without the risk of skin breakdown. The first of the two split drapes is secured to the posterior towel with the U-up wrapping around the front of the patient. The second split drape adheres to the anterior portion where the previous split drape closed U-down. The flanges are to

adhere laterally and extend under the patient's hip towards the foot of the bed. This seals the superior trunk and above that is out of the field under the ether screen on top of the forced air warmer. This minimises the chance of contamination and helps keep the child warm. The excess drapes are cut off to minimise contamination and drape movement during the procedure. An alternative is an extremity or "aperture" drape used in orthopaedic surgery. This allows the patient's torso to be slit through the aperture. Often, the aperture is too small and needs to be cut to the patient's circumference.

The patient's legs are wrapped in towels and Kerlix to minimise skin exposure and keep the child warm (Figure 3). At the end of the procedure, the child's legs will be medially rotated/adducted and clipped together to reduce the hips' external rotation and avoid placing tension on the abdominal closure. Care should be taken to prevent compression of the toes when wrapping the lower extremities, as they will not be visible for evaluation during the procedure. Finally, a laparotomy pad is placed over the patient's exposed bladder and secured with Ioban to protect the bladder during the orthopaedic procedure and prevent the mucosa from drying. This pad is removed at the start of the urological part of the procedure.

Conclusion

Classic bladder exstrophy is a rare but severe congenital defect seen in children that requires lifelong medical care and follow-up by a dedicated group of specialists. The primary closure is the beginning of helping a child to have a more normal life with a few modifications. For the patient to have the best possible outcome, a multidisciplinary team is needed before, during, and after the initial closure.

Conflict of interest

The author declares no conflict of interest.

Ethical approval

This work is exempt from the Institutional Review Board. The author declares that this submission follows the principles laid down by the Responsible Research Publication Position Statements developed at the Second World Conference on Research Integrity in Singapore in 2010. Permission was granted for patient photography. Moreover, no photographs contain personally identifying information.

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