Pediatrics

Intraoperative contrast enhanced sonourethrography to characterize urethral stricture in a pediatric patient

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ABSTRACT

Fluoroscopic retrograde urethrogram (RUG) is the current gold standard to define urethral strictures, however, sonourethrography (SU) has been shown to be effective in this setting as well. Some advantages of SU include more accurate measurement of stricture length, lack of radiation, and ability to assess soft tissue surrounding strictures to help guide operative management. Contrast enhanced ultrasound (CEUS) is an evolving imaging modality with increasing clinical utility in both pediatric and adult patient populations. We present a unique case in which contrast enhanced sonourethrography (CESU) was used to further characterize a urethral stricture intraoperatively to aid in surgical decision making.

Introduction

Fluoroscopic retrograde urethrogram (RUG) is the current gold standard to radiographically define urethral strictures. Urethral ultrasound has been used to enhance assessment of strictures since first described by McAninch in 1988 and was later shown to aid in decision making in 45% of patients undergoing anterior urethroplasty.1 The applications of contrast enhanced ultrasound (CEUS) in pediatric imaging are rapidly evolving. Here we present a unique case in which contrast enhanced sonourethrography (CESU) was used as an adjunct to grayscale sonourethrography (SU) to further characterize a patient’s urethral stricture intraoperatively and aid in surgical decision making. To our knowledge this is the first described use of CESU with second-generation contrast agents for this purpose.

Cases

The patient is a 17-year-old male with a two-year history of painful urination, straining, hesitancy and weak stream. A renal bladder ultrasound (RBUS) showed an elevated post void residual (PVR) and uroflowmetry demonstrated a plateaued, prolonged, saw-tooth voiding curve. In the operating room RUG demonstrated a focal bulbar urethral stricture and cystoscopy showed a tight bulbar stricture that could not accommodate a 9.5F scope, so a suprapubic tube was placed (Fig. 1A).

Four weeks later he returned to the operating room for formal repair with urethroplasty. In order to define the length of stricture and select an optimal surgical technique, CESU using 0.1% solution of Optison™ diluted in normal saline was performed intraoperatively. Contrast solution was instilled via suprapubic tube and a catheter in the fossa navicularis while the urethra was imaged with an ultrasound probe on the perineum (Fig. 1B). This demonstrated a 3.3–4.9mm long stricture beginning 1.7cm distal to the external sphincter that appeared hyper-echoic, suggestive of dense spongiosfibrosis. Based on the imaging characteristics, excision and primary anastomosis (EPA) was performed. The patient recovered well from surgery and had his catheter removed after successful percutaheter RUG and VCUG confirmed no extravasation at 3 weeks.

Discussion

The role of ultrasound in surgical planning for urethroplasty has been previously described, however CESU may offer particular...
advantages in pediatric patients. It is radiation-free, decreases the need for lying still in uncomfortable positions needed for fluoroscopic imaging, allows for a parent to comfort and stay with the child more easily, and can characterize the tissue surrounding the urethra allowing assessment of spongiofibrosis.\textsuperscript{1} Whereas fluoroscopic RUG depicts luminal anatomy alone, the definition of periurethral tissue disease by CESU can help further inform surgical planning.

Another benefit of ultrasound is improved accuracy of measurement. Bryk et al. showed pre-operative SU performed with saline to be an accurate measure of stricture length when compared with intraoperative measurements at the time of repair. Among 24 adult patients, they found a non-significant difference between these measurements and a correlation coefficient of 0.84.\textsuperscript{2} Other studies have demonstrated the superiority of saline SU over fluoroscopic RUG to more accurately predict stricture length at time of repair.\textsuperscript{3,4}

Stricture length and degree of spongiofibrosis are important in pre-operative planning as they dictate the technique selected. Short, whispy bulbar urethral strictures are appropriate for a trial of endoscopic management. EPA is used for dense strictures with heavy spongiofibrosis whereas newer techniques such as non-transecting repairs or stricturoplasty may be considered in shorter strictures with less spongiofibrosis. Longer, more complex strictures are often primarily managed with substitution urethroplasty utilizing buccal mucosal or tissue flaps. Intraoperative CESU confirmed a short, dense bulbar urethral stricture in our patient and was a major factor in choosing EPA.

Buckley et al. reviewed 232 patients who underwent anterior urethroplasty and compared stricture length on preoperative fluoroscopic RUG, intraoperative SU, and direct measurement.\textsuperscript{1} They also assessed the effect that SU had on the surgical technique used compared to preoperative plan. They found that SU, performed with aerated lubricant mixed in saline, altered the surgical technique in 19% of cases and helped make a decision between techniques in another 26%. In those cases where the approach was changed from EPA to onlay urethroplasty, RUG significantly underestimated stricture length whereas in those changed from onlay to EPA, RUG length was significantly longer than SU. In both scenarios the intraoperative length was closer to the SU than RUG measurement. This illustrates the role SU plays in effective operative planning.\textsuperscript{1}

Contrast agents may further enhance sonographic definition of urethral stricture anatomy. These microbubble agents enhance the reflection of sound and improve tissue contrast. Commercial ultrasound manufacturers have software capabilities that can further subtract signal from background tissue.\textsuperscript{5} Peskar and Perovic are the only authors who have described CESU previously. They performed CESU in 13 patients felt to have particularly long, severe strictures with Levovist®, a first generation sonographic contrast medium, to better define anatomy. The authors comment that the contrast helped to better delineate the lumen as well as show reflux into Cowper’s glands and extravasation but did not specifically compare this small group of patients to others in terms of accuracy or outcomes.\textsuperscript{4} Since this study, second-generation contrast agents with increased microbubble stability, allowing for longer visualization by ultrasound, are now commercially available.

Conclusions

We describe a case where intraoperative CESU helped define a patient’s urethral stricture disease and inform surgical planning. Since our initial experience, we have used this technique for two additional cases and found it to be similarly helpful. Though data has existed for almost 30 years suggesting that SU is a useful adjunctive tool in assessing urethral strictures, it is not widely used today. We suspect this is primarily because it requires a radiologist to come to the operating room or a urologist to become facile with the imaging technique. Though both of these options are feasible, they may increase operative time, particularly during the learning phase. For institutions who already use SU, the addition of contrast would present a simple transition.

Our case is unique because although intraoperative SU has been previously described, use with second-generation ultrasound contrast agents has not been reported. This technology may augment fluoroscopic imaging or ultimately replace RUG and supplement intraoperative SU in certain populations. Further experience and investigation are needed to optimize its role.

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None.

Declaration of competing interest

None.

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