

# Go With The Flow:

## VCUG vs. ce-VUS in Diagnosing Vesicoureteral Reflux in Pediatric Patients

### Introduction

Vesicoureteral reflux (VUR) is a disorder involving the retrograde flow of urine from the urinary bladder into one or both ureters and possibly the renal collecting system(s). VUR affects 25-40% of all children<sup>1</sup> and approximately 30% of children presenting with urinary tract infections<sup>2</sup>. Voiding cystourethrography (VCUG) has been the gold standard technique used to evaluate and diagnose VUR<sup>2</sup>. Contrast-enhanced voiding urosonography (ce-VUS) is an innovated, radiation free, technique that has been proven to be superior to VCUG in diagnosing and grading VUR in pediatric patients.

### Causes & Effects of VUR

Vesicoureteral reflux is primarily caused by a faulty valve, that is present from birth, between one or both ureters and the urinary bladder. VUR is commonly diagnosed in infants and children during urinary tract infection evaluation or postnatal follow-up of prenatally diagnosed hydronephrosis. Early detection of VUR and treatment with prophylactic antibiotics or surgery is extremely important<sup>1</sup>. VUR can cause infection, hypertension, protein in the urine, and nephropathy, leading to chronic renal failure over time.

### Technical Approach

#### VCUG

#### Ce-VUS

- Position patient on table
- Take **preliminary images**
- Clean genital area
- Insert urinary catheter into urethra
- Tape catheter to skin so it won't be dislodged during the procedure
- Fill bladder via catheter with **contrast agent**
- Have patient void when bladder is full
- Monitor bladder, ureters, & kidneys with **imaging** with bladder filling & emptying
- Remove catheter

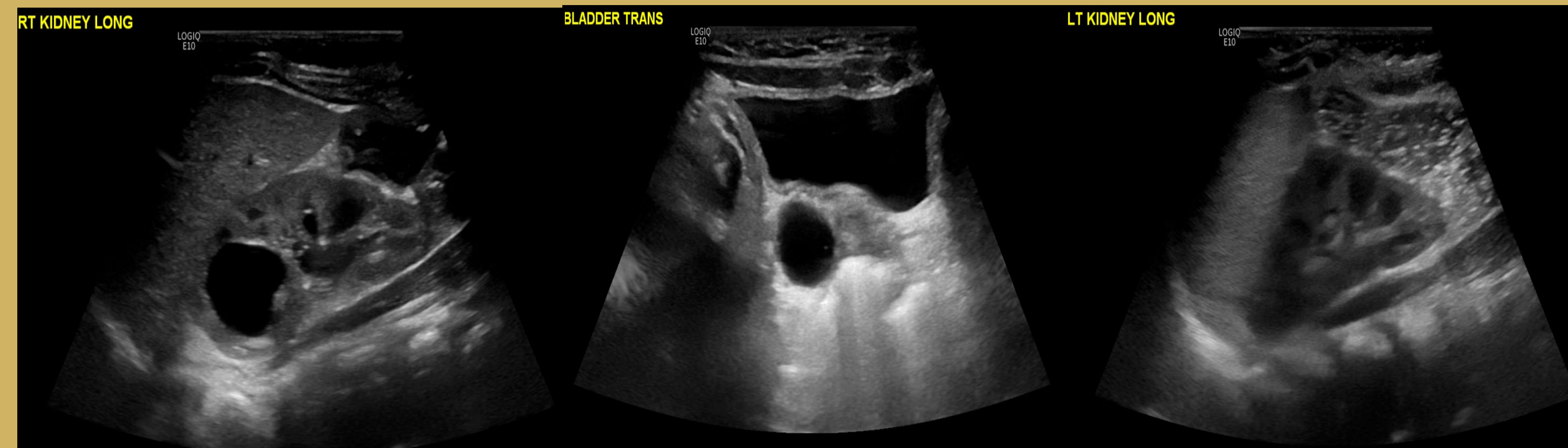
- Preliminary images using x-ray
- Radio-opaque contrast media
- Monitor with an x-ray imaging technique known as fluoroscopy

- Preliminary images using ultrasound
- A mixture of normal saline & microbubble contrast material
- Monitor with ultrasound imaging

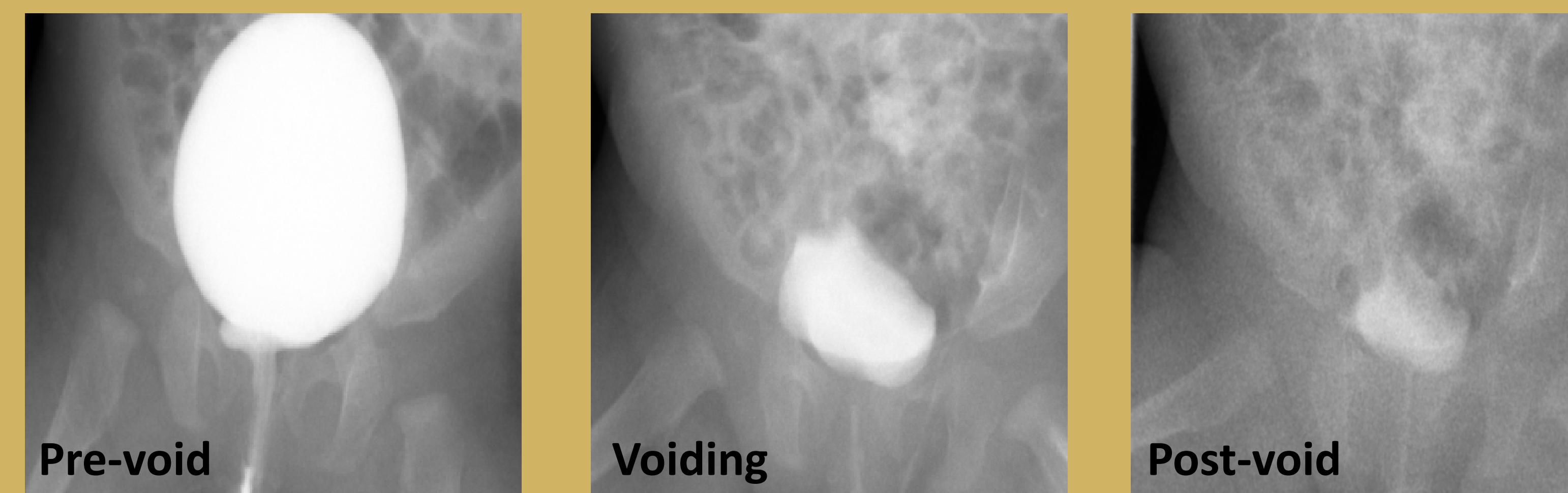
### Case Review

**Patient History:** 3 month old female with prenatally diagnosed right duplicated collecting system and right upper pole hydronephrosis. Patient presents with frequent febrile UTIs. Patient underwent both a VCUG and a ce-VUS on the same day, with the same facility performing both studies.

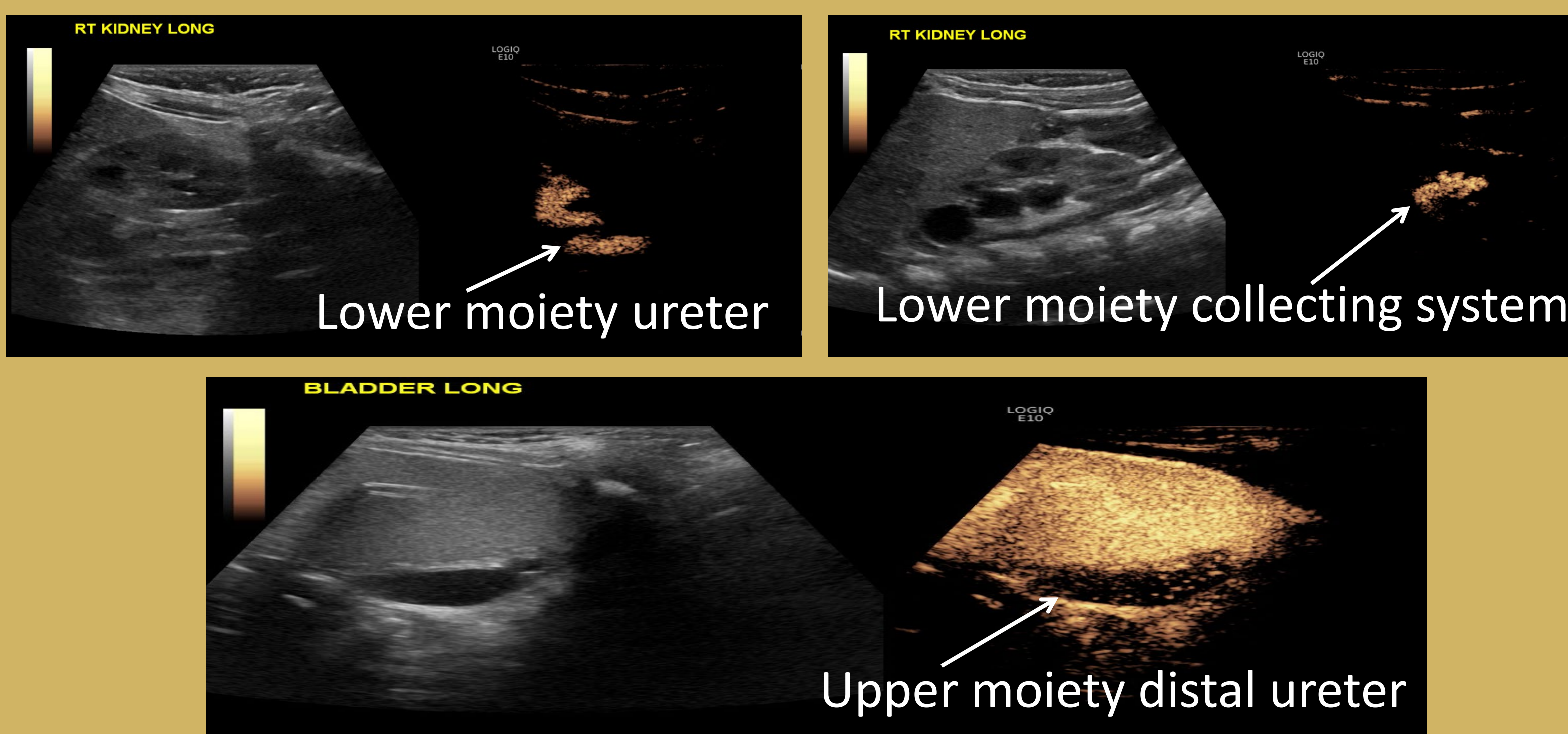
**Preliminary non-contrast US demonstrates:** Right duplex collecting system with dilated upper pole, and upper pole ureter terminating in a low ectopic ureterocele. Normal left kidney.



**VCUG demonstrates:** Small impression on the bladder neck from the right noted during early filling, with **Cystoconray**, which later everted with voiding- consistent with low right ectopic everting ureterocele. No VUR was demonstrated before, during, or post void.



**Ce-VUS demonstrates:** Grade II reflux into the right kidney lower moiety with moderate bladder filling, with **normal saline and Lumason**. Grade I reflux into the right kidney upper moiety distal ureter with voiding. No reflux was observed in the left kidney or left ureter.

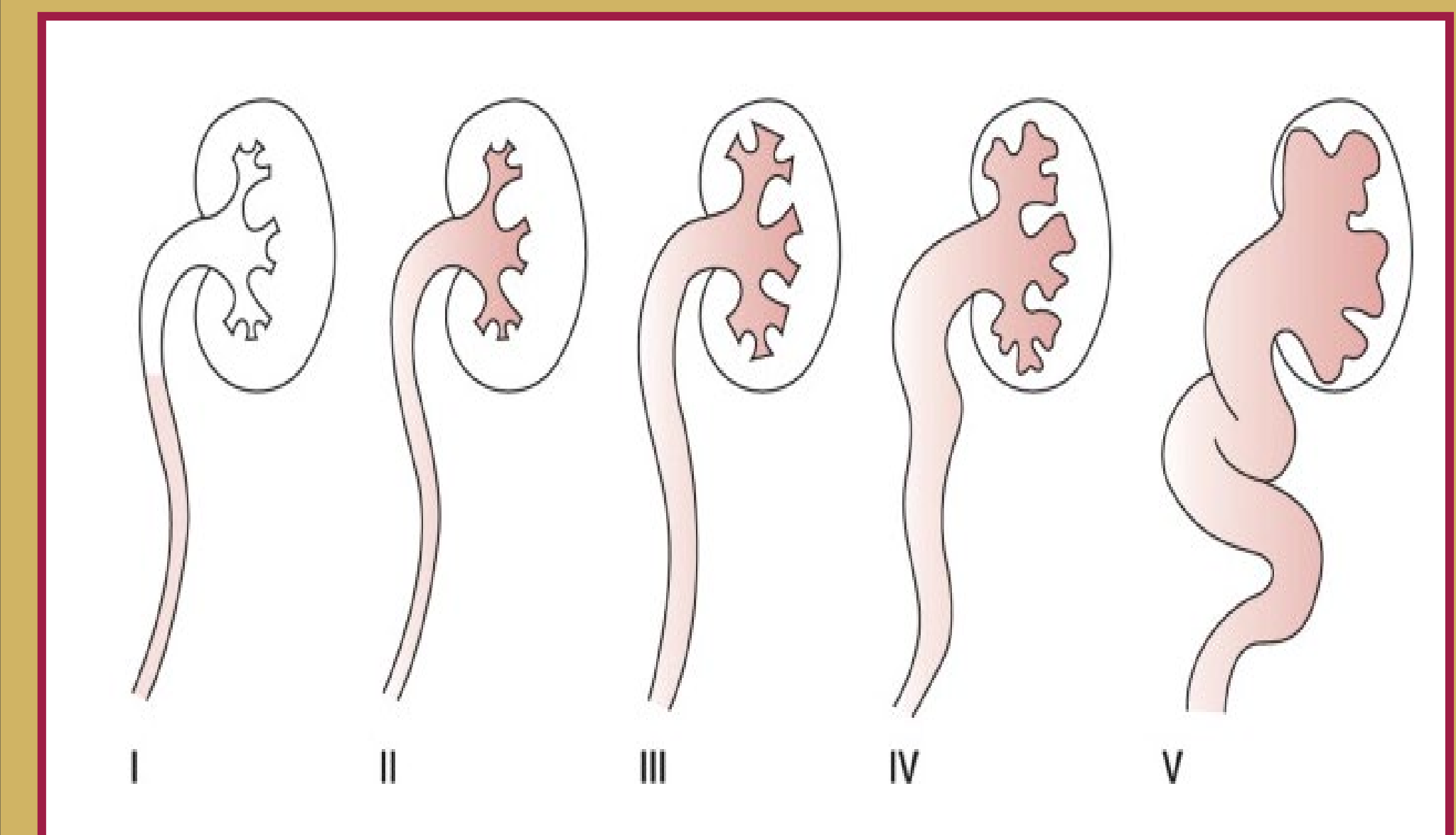


#### Patient follow up:

Patient underwent right upper heminephrectomy, right nephropexy, & right lower pole ureteroureterostomy 3 months post VCUG and ce-VUS. The patient has not had a UTI since the surgical procedure was performed.

### Discussion

The case presented demonstrates that ce-VUS is more sensitive than VCUG in detecting the presence, grade, and severity of VUR in pediatric patients. VCUG, when compared to ce-VUS, often underestimates or misses VUR. This is shown to be accurate in the presented case where grade I and II VUR was not detected on the VCUG but was detected on the ce-VUS. VUR is graded on a scale from I-V, with I being the least severe and V being the most severe. Grading is based on the height of retrograde flow, dilatation and tortuosity of the ureter(s), and renal collecting system involvement (Figure 1<sup>3</sup>).



**Figure 1:** Grading of VUR into five grades according to the International Reflux Study in Children System

### Conclusion

Ce-VUS is a highly efficient, reliable, safe technique that has several advantages over VCUG. Not only is ce-VUS more sensitive in detecting VUR in pediatric patients, it also lacks radiation exposure. VCUG is performed under radiation emitting fluoroscopy guidance. Most urological patients that have VUR undergo several repeat VCUG procedures to evaluate resolution or worsening of VUR. Radiation free ce-VUS can be repeated frequently, increasing compliance with the Image Gently Alliance and the ALARA principle, without negatively affecting the patient. Also, unlike VCUG, ce-VUS utilizes real time dynamic imaging which allows radiologists and sonographers to evaluate the path of the microbubble contrast media over a longer period of time. The extended period of observation can aid in the detection of higher grade VUR, if present. Although ce-VUS is a relatively new operator- dependent technique requiring skilled sonographers, it is with hope that it will adequately replace VCUG in the near future.

### References

1. Tullus K. Vesicoureteric reflux in children. Lancet. 2014Aug24;385(9965):371-379.
2. Mane N, Sharma A, Patil A, Gadekar C, Andankar M, Pathak H. Comparison of contrast-enhanced voiding urosonography with voiding cystourethrography in pediatric vesicoureteral reflux. Turk J of Urol. 2017.
3. Williams G, Fletcher J, Alexander S, Craig J. Vesicoureteral reflux. JASN. 2008 May;19(5): 847-862.