CONGENITAL DISEASE RENAL ULTRASOUND

Louise Hattingh

Consultant radiologist

Bradford teaching hospitals

NO DISCLOSURES

OUTLINE

- Normal
- Abnormalities of renal size
- Abnormalities of renal position
- Dilated urinary tracts

- Top tips for scanning

NEONATE/INFANT RENAL US MORPHOLOGY

*Foetal lobulation

*Renal cortex more echogenic (=liver/spleen)

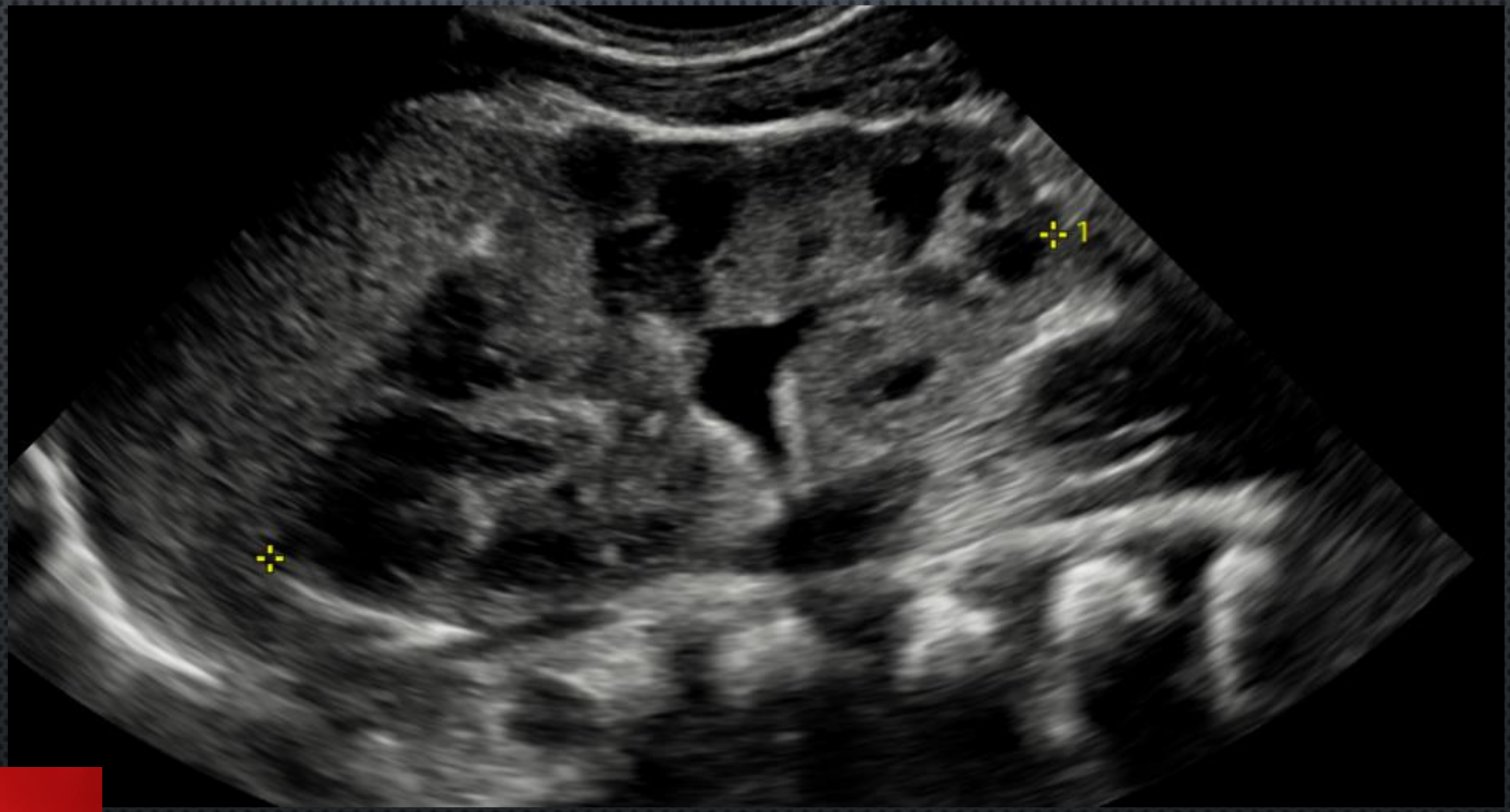
*Prominent hypoechoic pyramids

*Paucity of renal sinus fat


1

Transient Medullary Echogenicity

- It is thought Related to Tamm-Horsfall protein
- Cast deposition in tubules
- Usually healthy term babies
- Normalises within 6-8 days of life
- May find some echogenic material in the bladder
- TIP: Follow up ultrasound



Top Tip: Follow up

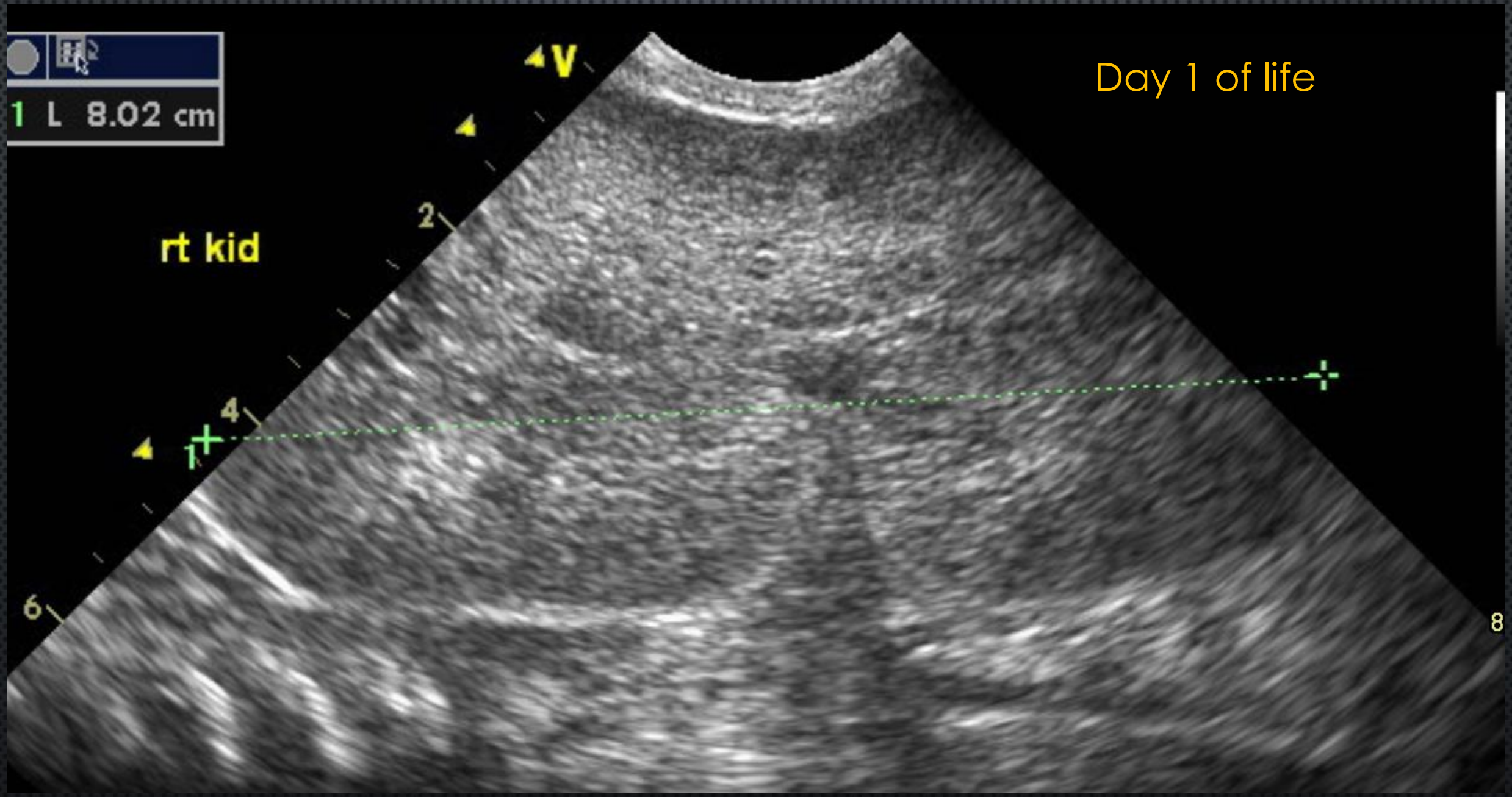
ADULT PATTERN BY 7 MONTHS:

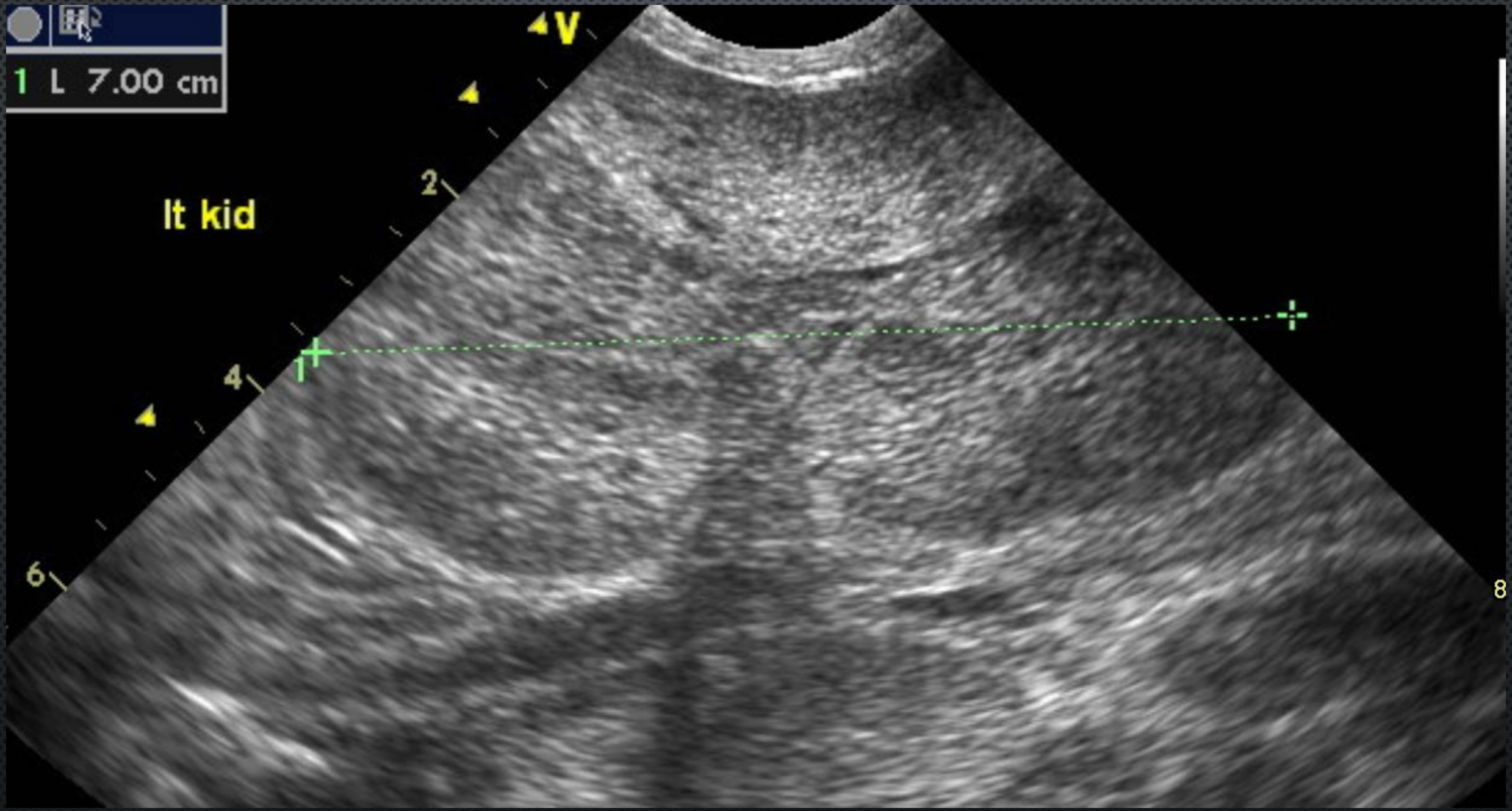
- RENAL CORTEX < LIVER/SPLEEN
- RENAL SINUS > LIVER
- MEDULLAE REMAIN HYPOECHOIC, LESS PROMINENT
- JUNCTIONAL PARENCHYMAL DEFECT: NOT A SCAR

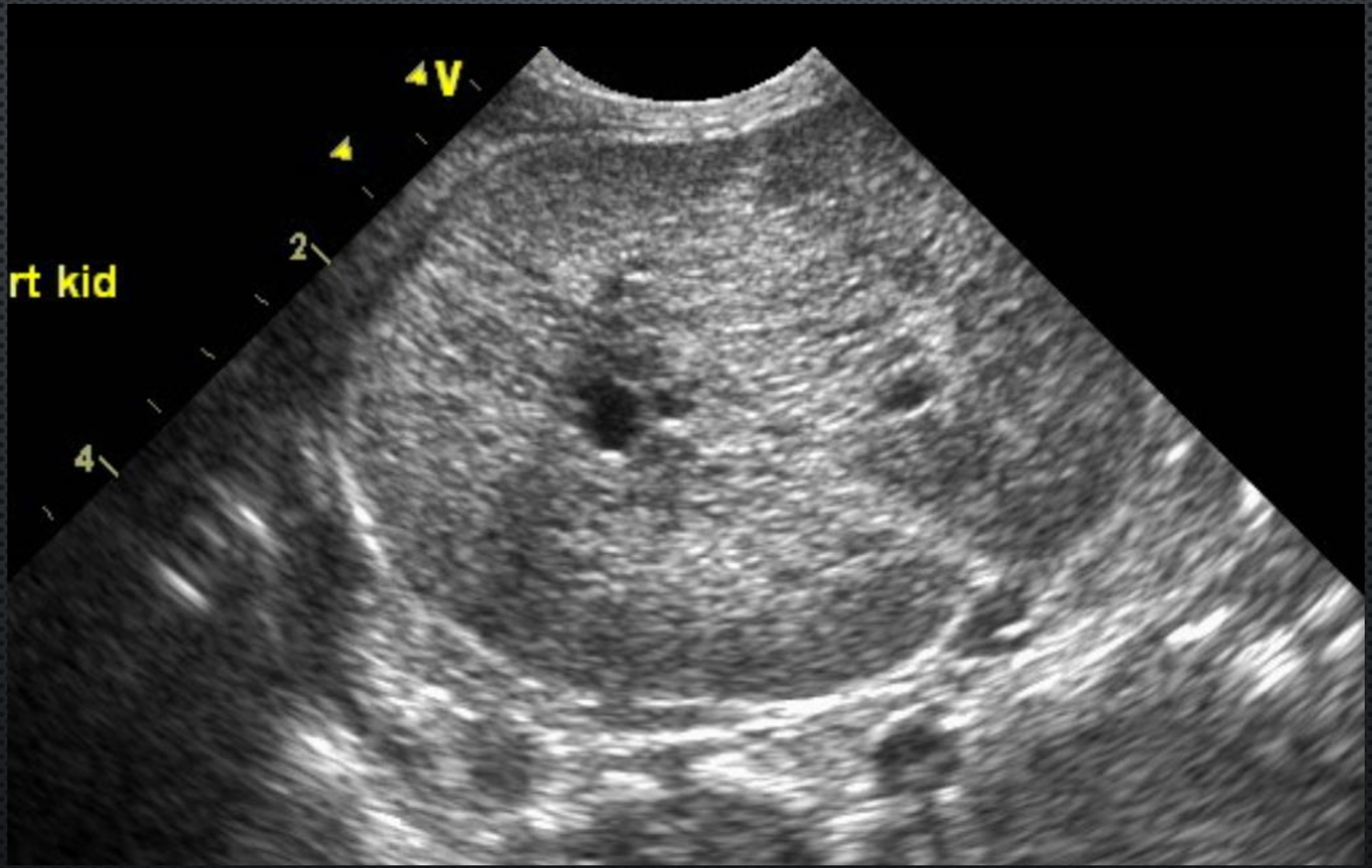
ABNORMALITIES OF RENAL SIZE

SIZE MATTERS

- Renal Size: routine use of normograms
- Neonatal size about 10mm for 10 weeks gestation
- Exceptions: solitary & duplex kidney


1 L 8.02 cm
rt kid
Day 1 of life


1 L 7.00 cm
lt kid
2
4
6
8


V
2
4
rt kid

Autosomal recessive polycystic kidney disease: ARPKD

- Variable age at presentation
- Neonatal presentation; severe renal involvement often fatal
  - history of oligohydramnios
- Later presentations: liver fibrosis, liver biliary dilatation (Caroli's disease) more common

TOP TIPS:

- Colour doppler – is there renal vein flow?
- Are there any cysts?
- The absence of macroscopic cysts doesn't exclude polycystic kidney disease
- Here the kidneys are bright because of the multiple reflective interfaces of the microcysts

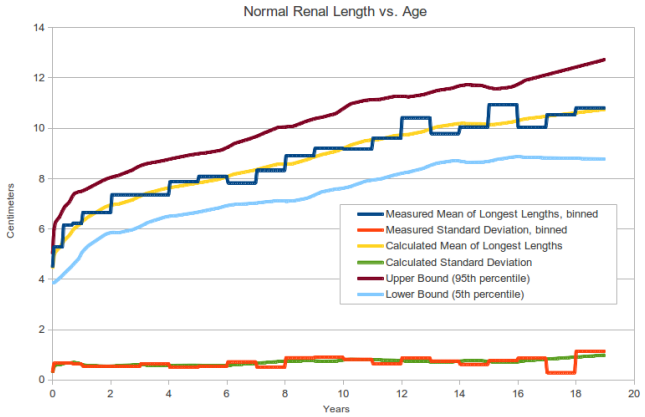
Pediatric Kidney Size Percentile Calculator

contributed by Michal Kulon, MD on 9/15/2015

	Year	Month	Day
Date of Scan:	2024	12	3
Date of Birth:	2024	12	3
Right Kidney:	8	cm	
Left Kidney:	7	cm	

Calculate Percentile

For age of 0 years 0 months 0 days, the average kidney length is 4.43 cm and standard deviation is 0.29 cm.
Right kidney length of 8 cm corresponds to 100 percentile (12.36 standard deviations above the mean).
Left kidney length of 7 cm corresponds to 100 percentile (8.9 standard deviations above the mean).



Methods

- Normal range data based on "Sonographic Assessment of Renal Length in Normal Children" AJR 142:467-469, March 1984
- Source data consists of 203 patients under 19 years old. However, this population is divided into numerous age intervals, with each interval containing relatively few patients (4 to 54). This yields good overall regression, but relatively poor statistical quality within some of the individual age intervals, leading to several spurious results such as the mean kidney size within the 15-16 year old group being apparently larger than for the older ages of 16-17 year old.
- This calculator smooths out the spurious results by performing multiple linear regressions, each linear regression centered at the age of interest, spanning relatively short age range. Exceptions are made for youngest and oldest age groups, where it not possible to center the linear regression, and also for ages under 3 years old, where linear regression over several years is not appropriate due to the curvature of the data for this age range. In calculating regression, higher weight is given to the age inteval containing more patients.
  - Ages 0 to 1 month: linear regression spans age 0 to 1 month.
  - Ages 1 month to 3 years old: linear regression spans +/- 1 age intervals.
  - Ages 3 to 17: linear regression spans 5 year interval centered at the 1-year age interval of interest (i.e. +/- 2 age intervals).
  - Ages 17 to 19: linear regression spans 4 year interval 15 to 19 years old.
- Calculation of percentiles assumes non-skewed, approximately normal distribution, and that the mean approximately equals the median.

Additional Resources

- Multivariate kidney size percentile calculator requiring age, gender, ethnicity, height, and weight.

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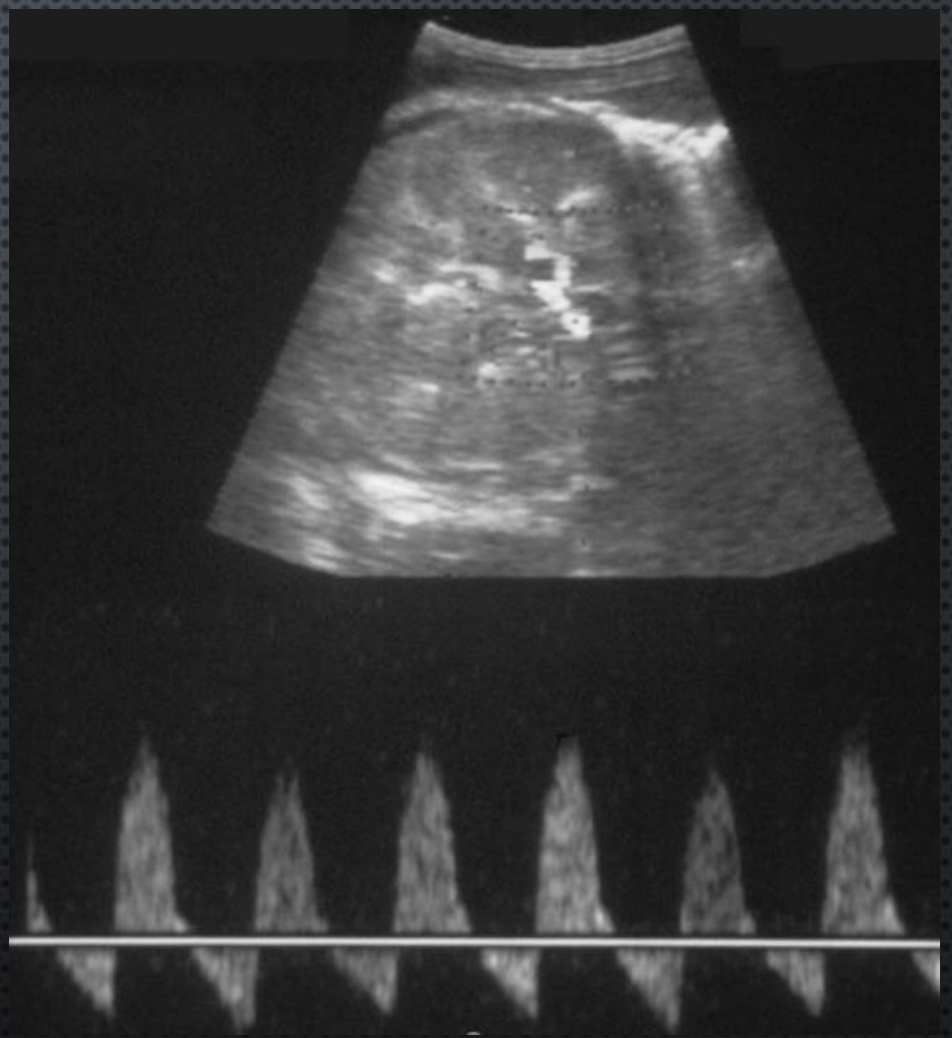
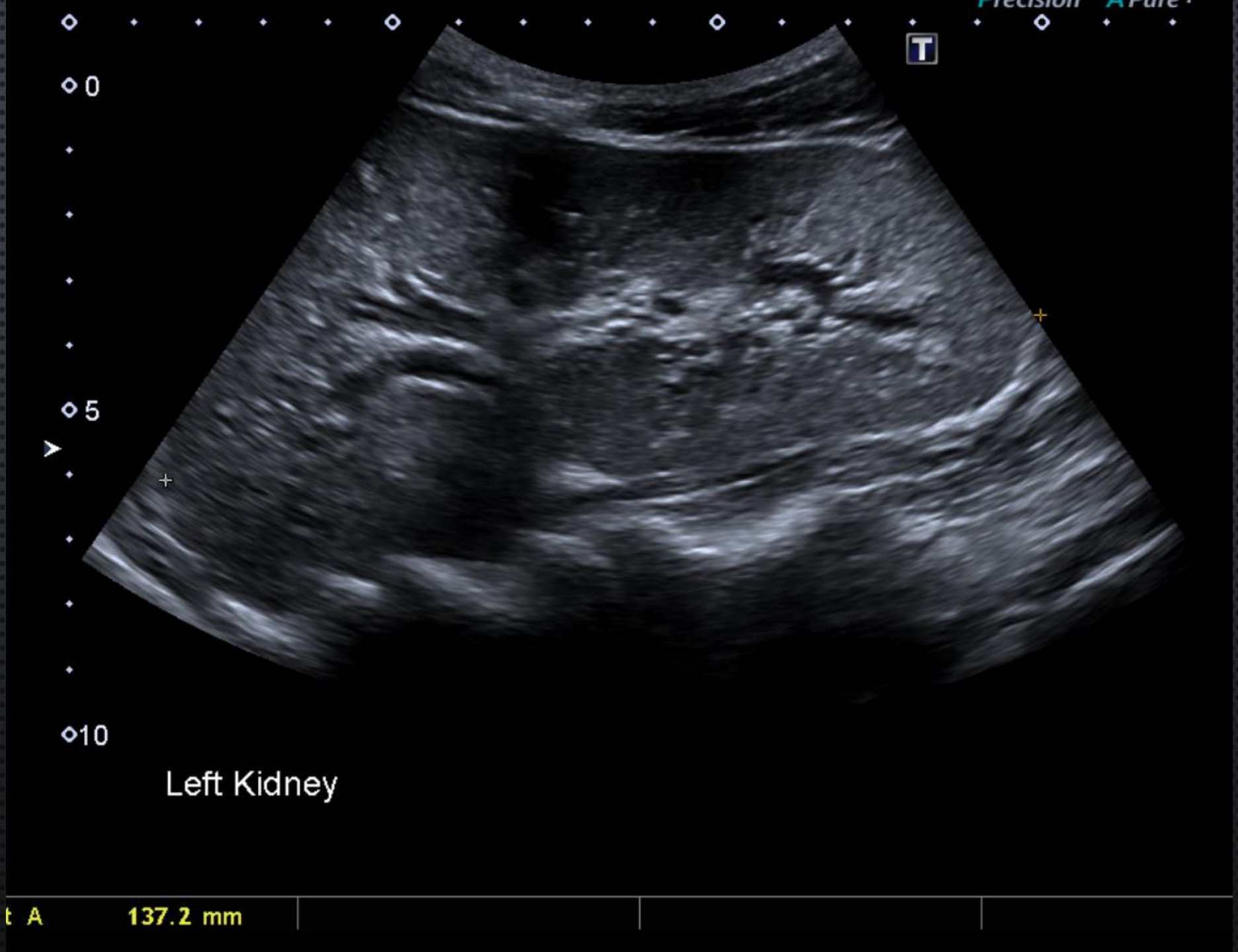
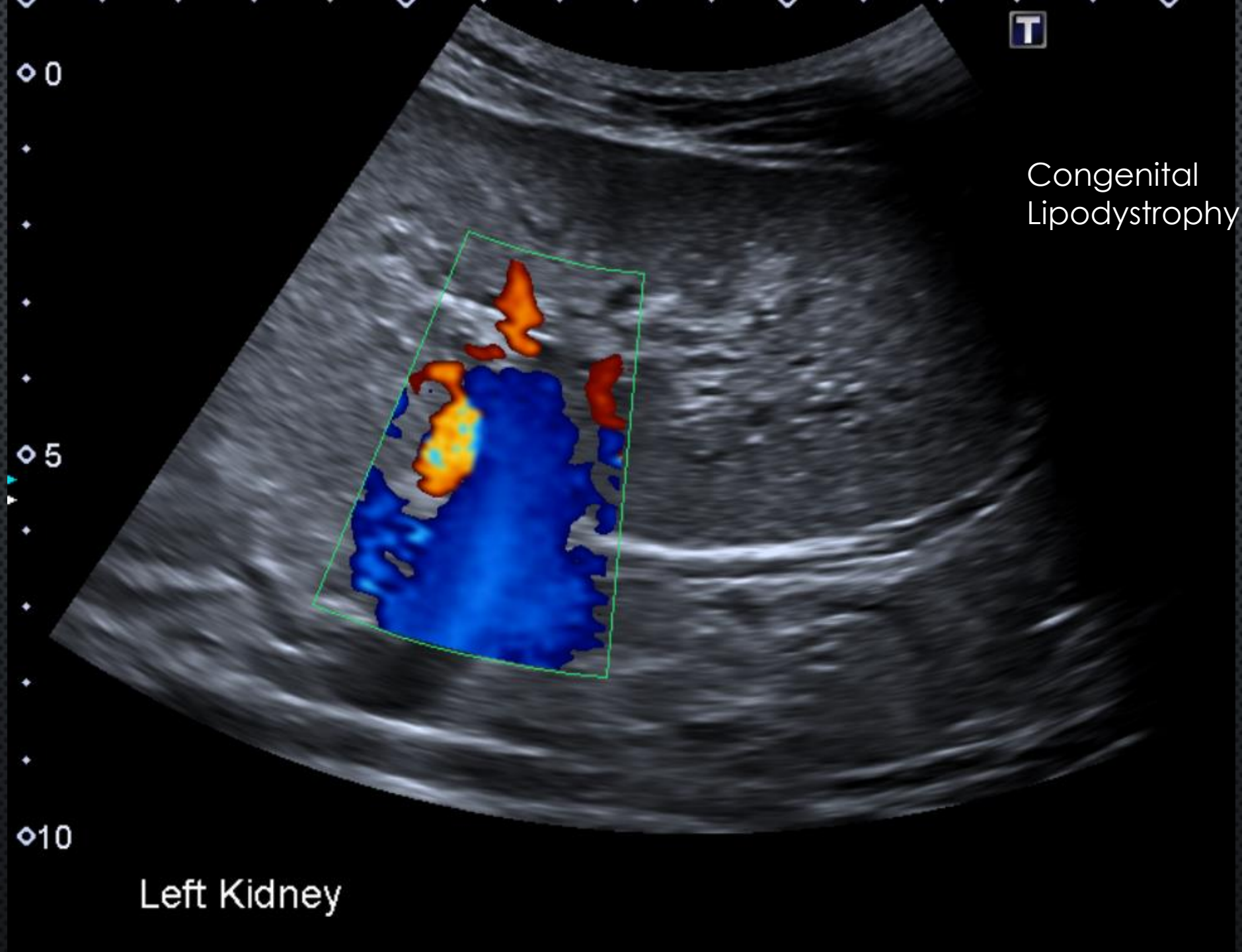
ANOTHER BIG, BRIGHT NEWBORN KIDNEY…



Renal Vein Thrombosis

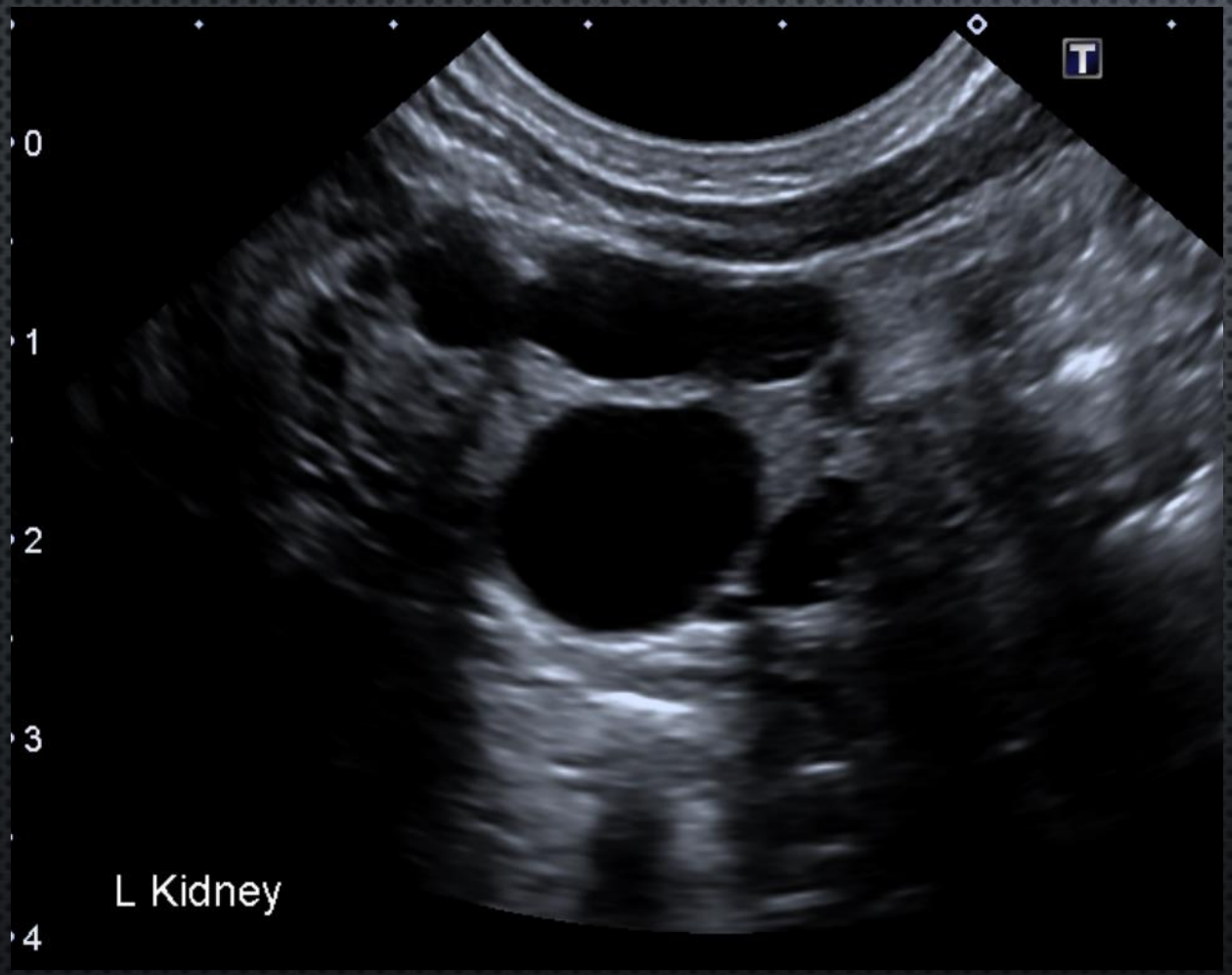
14 yo F

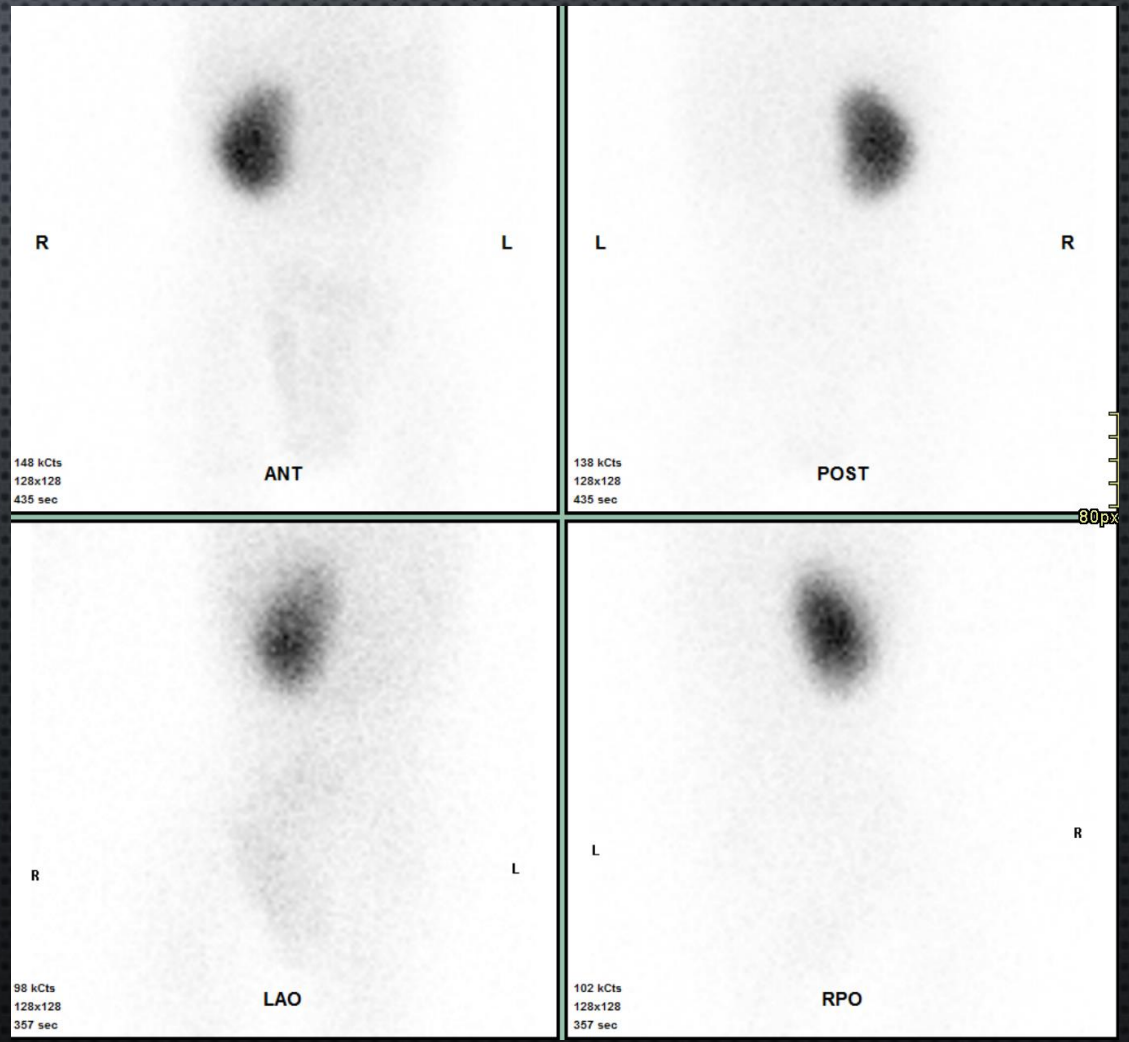




Congenital
Lipodystrophy 14yo F

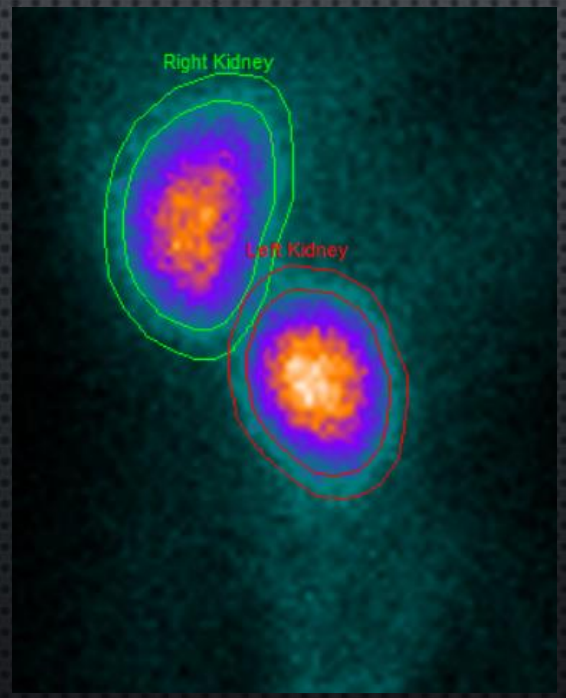
MULTICYSTIC DYSPLASTIC KIDNEY



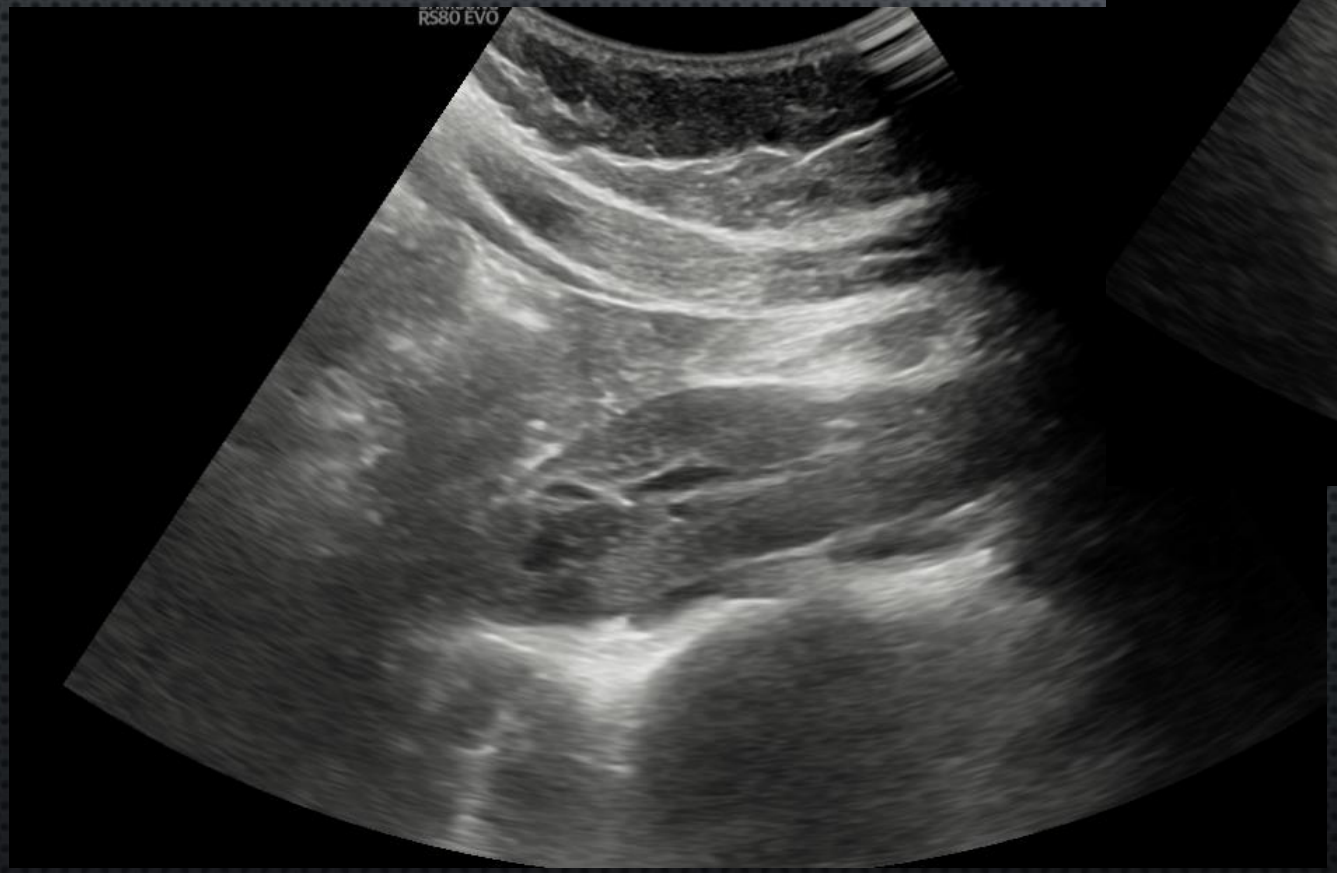


ABNORMALITIES OF RENAL POSITION

- HORSESHOE KIDNEY
- PELVIC KIDNEY
- CROSSED FUSED ECTOPIA



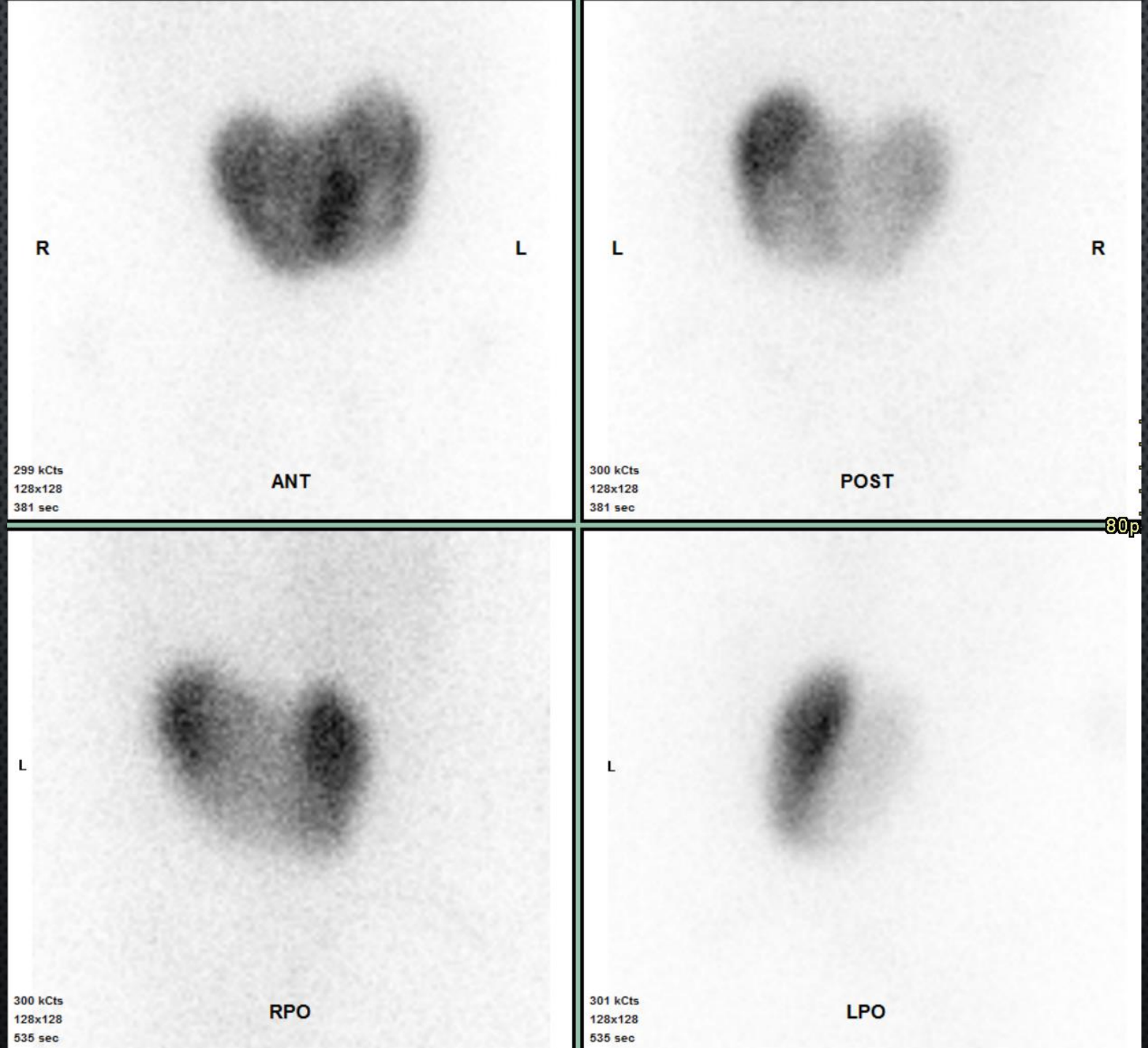
HORSESHOE



TOP TIP:

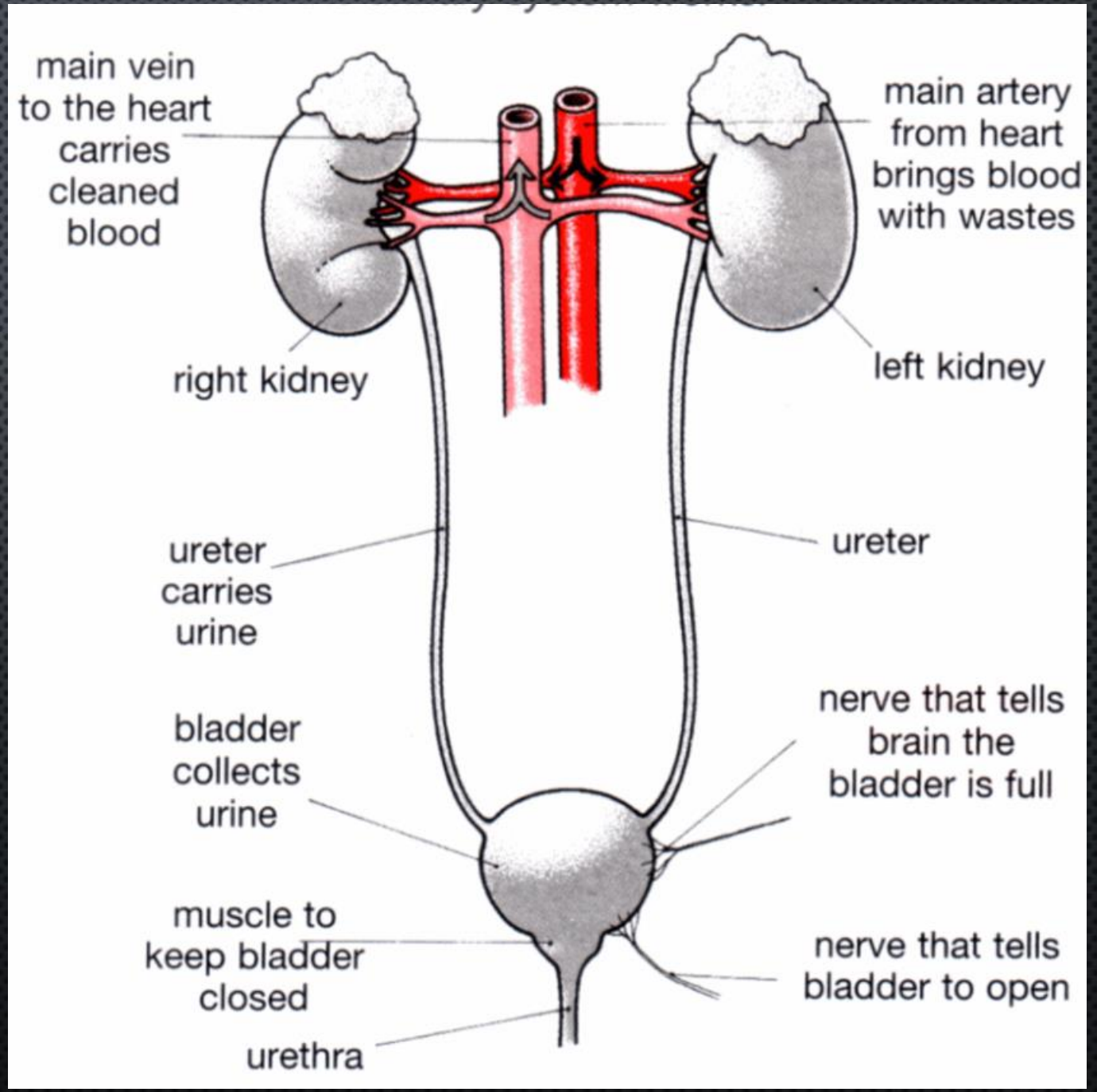
Always be 100% sure you've seen the whole lower pole.

Check the midline.


R
L
299 kCts
128x128
381 sec
ANT
L
R
300 kCts
128x128
381 sec
POST
L
300 kCts
128x128
535 sec
RPO
L
301 kCts
128x128
535 sec
LPO

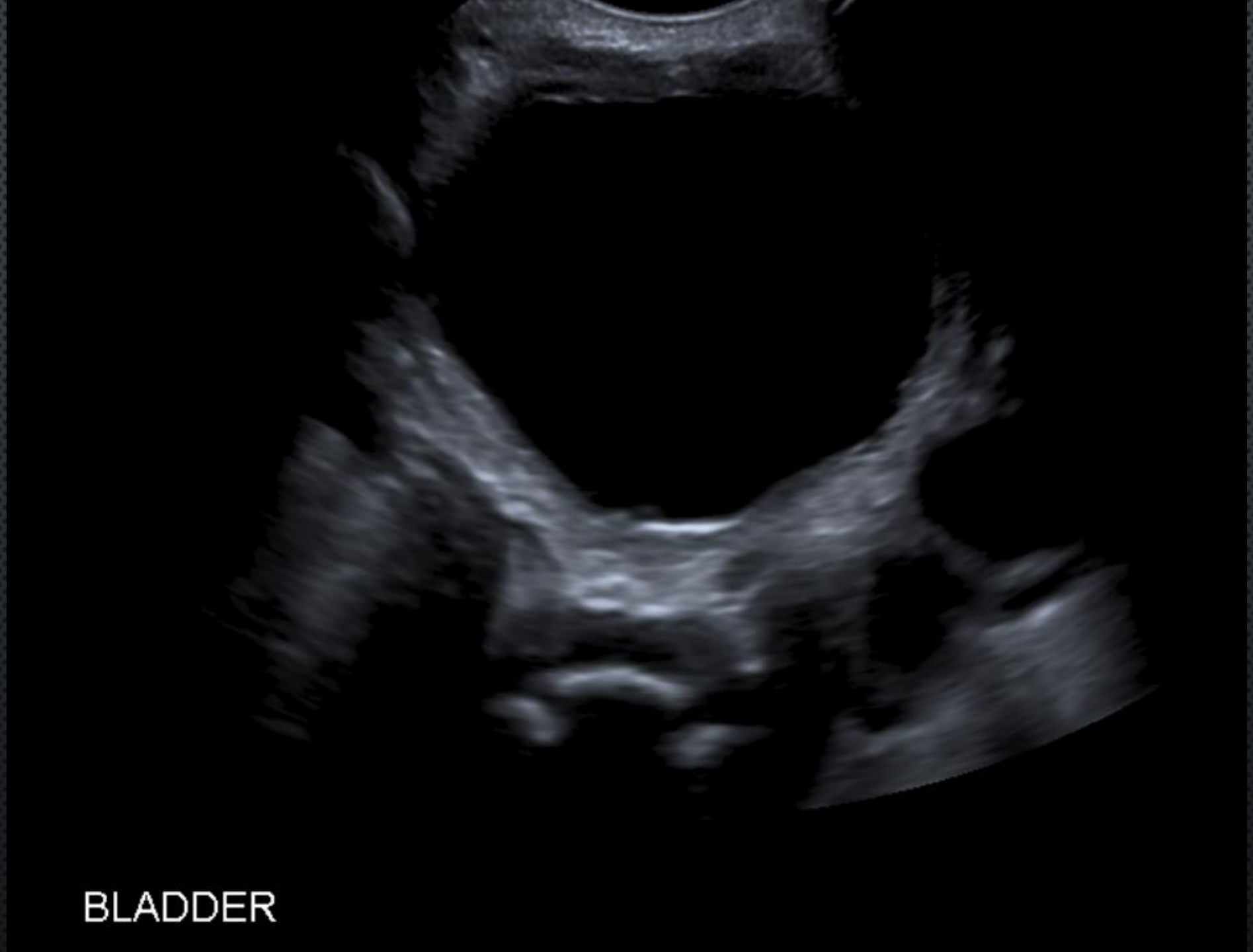
Dilated urinary tracts

- Think like a plumber: follow the flow!
- Also think: What does the treating decision-maker need to know?

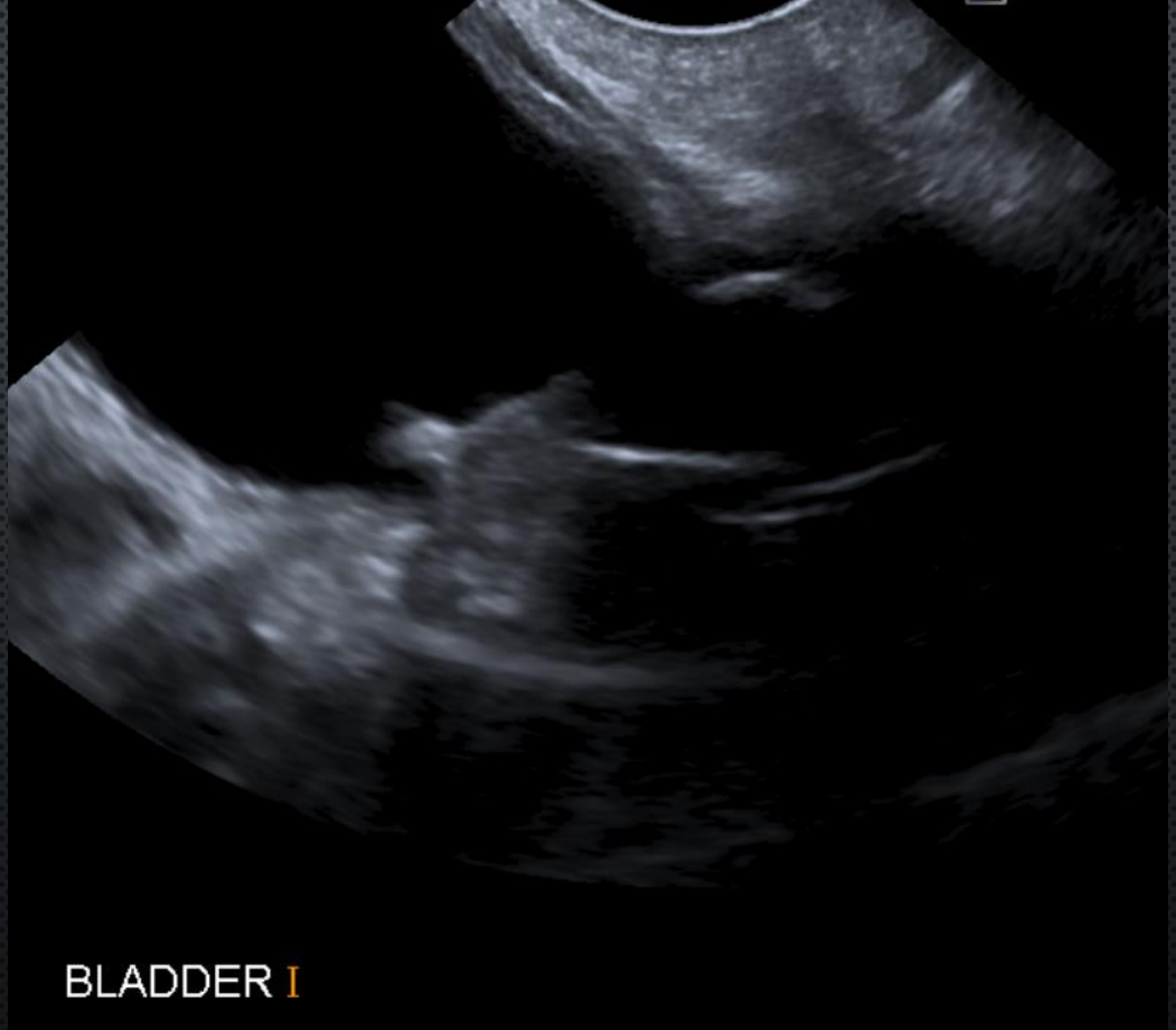


THE DILATED SYSTEM

- Obstruction to bladder outflow- eg posterior urethral valves
- Leaky vesico-ureteric junction: reflux
- Obstruction at pelvi-ureteric junction: PUJO
- Something blocking urinary passage along the way, eg ureteric calculus
- The bladder muscle isn't receiving the signals to void: the neuropathic bladder

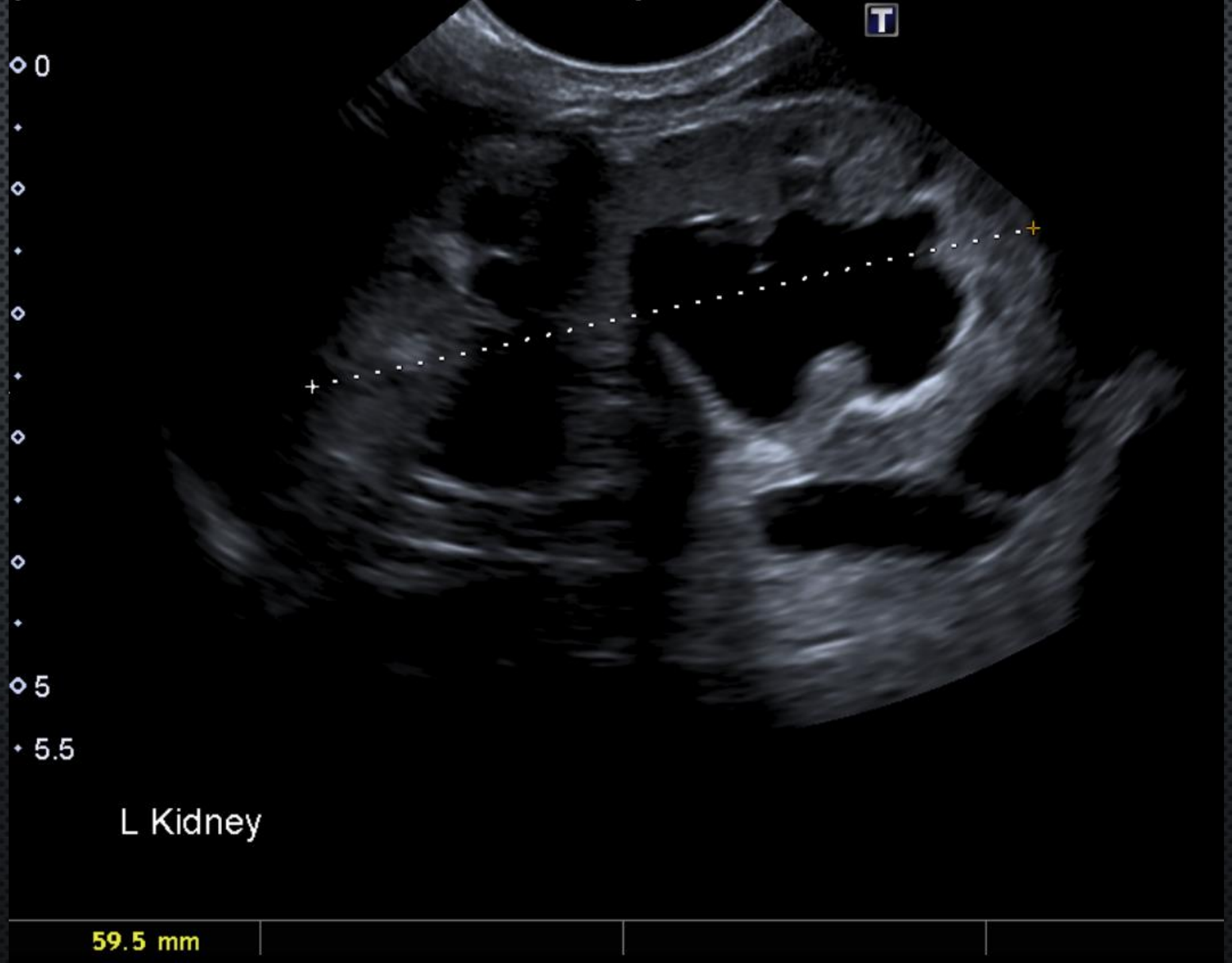

BLADDER

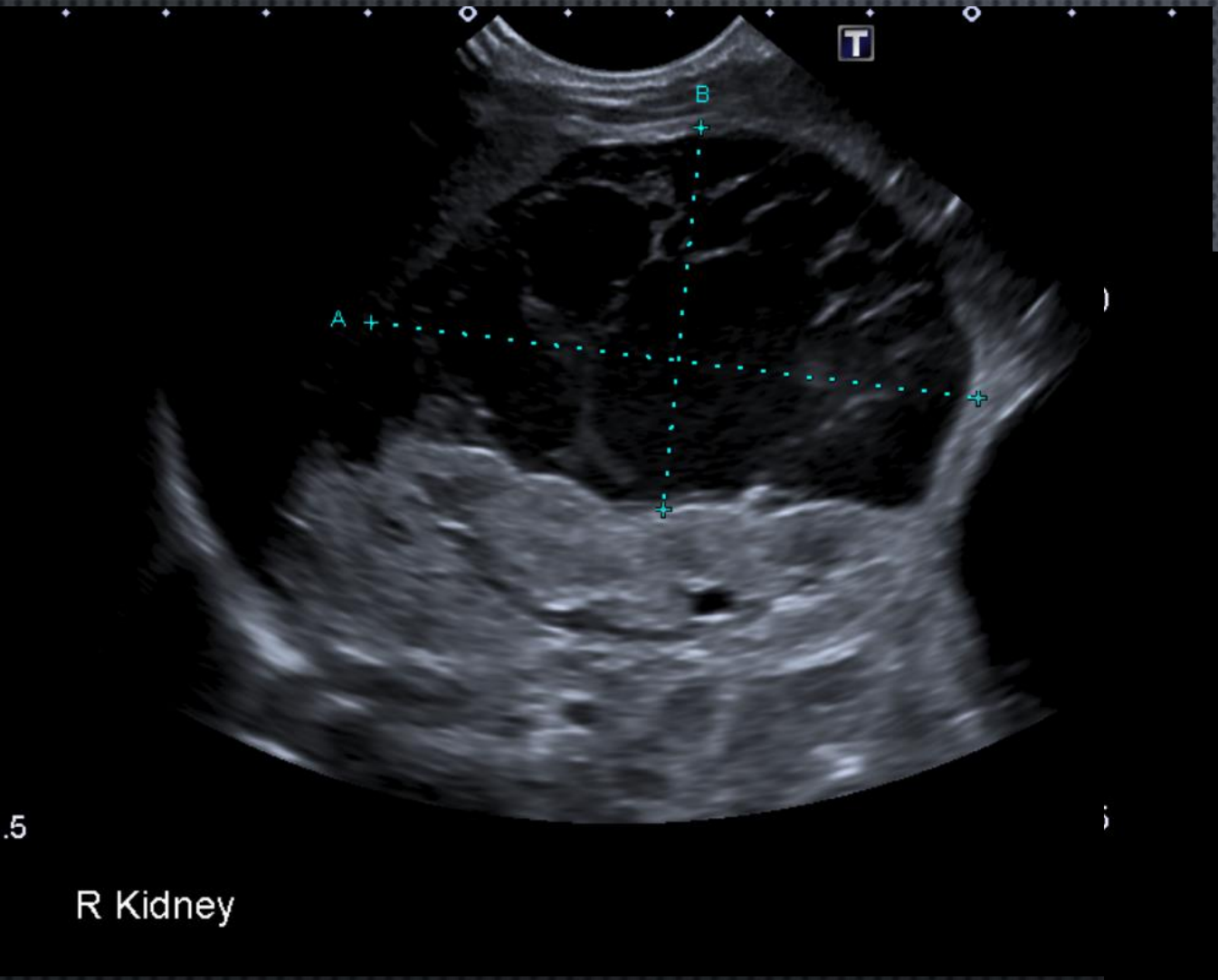

0
6
BLADDER I

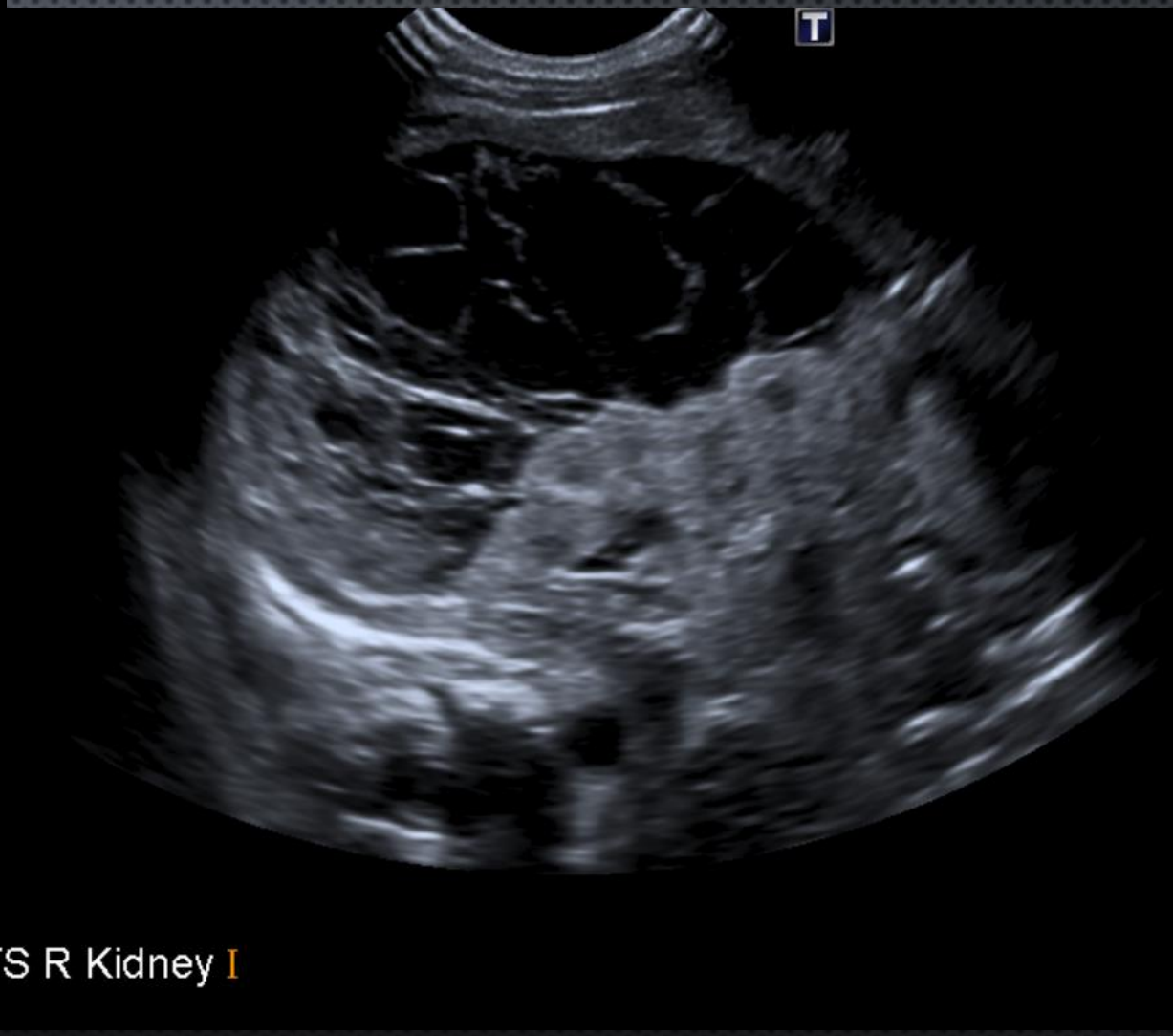

BLADDER I

Scan low, try to show a dilated posterior urethra: Keyhole sign

Try transperineal view with a linear probe


0
5
5.5
L Kidney
59.5 mm


B
A
.5
R Kidney


.5
TS R Kidney I

Posterior urethral valves:

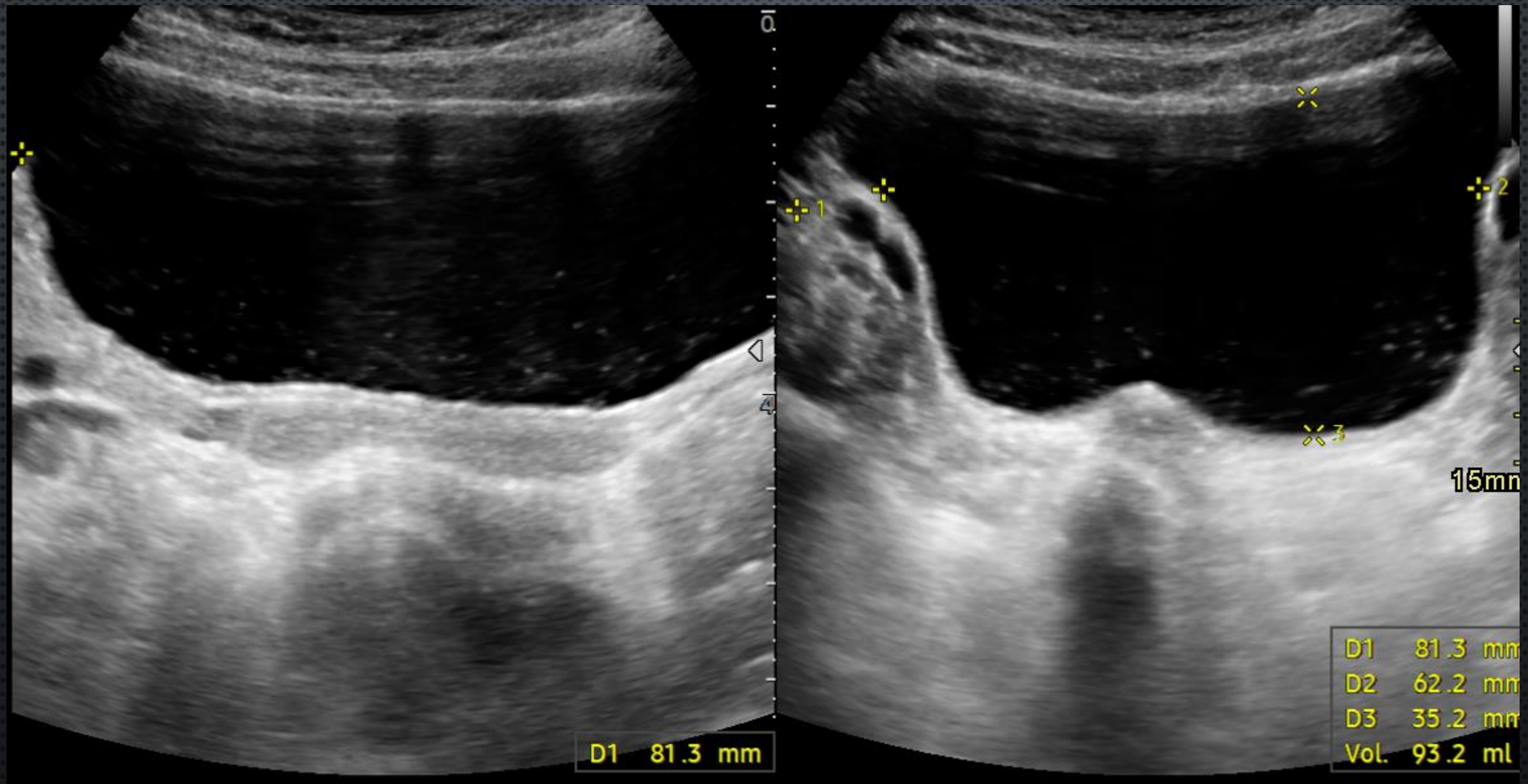
- Dilated bladder
- Dilated ureter(s)
- Dilated kidney left
- Decompressed kidney right, with
- Urinoma
- May have associated renal dysplasia

- Treatment: Endoscopic valve ablation

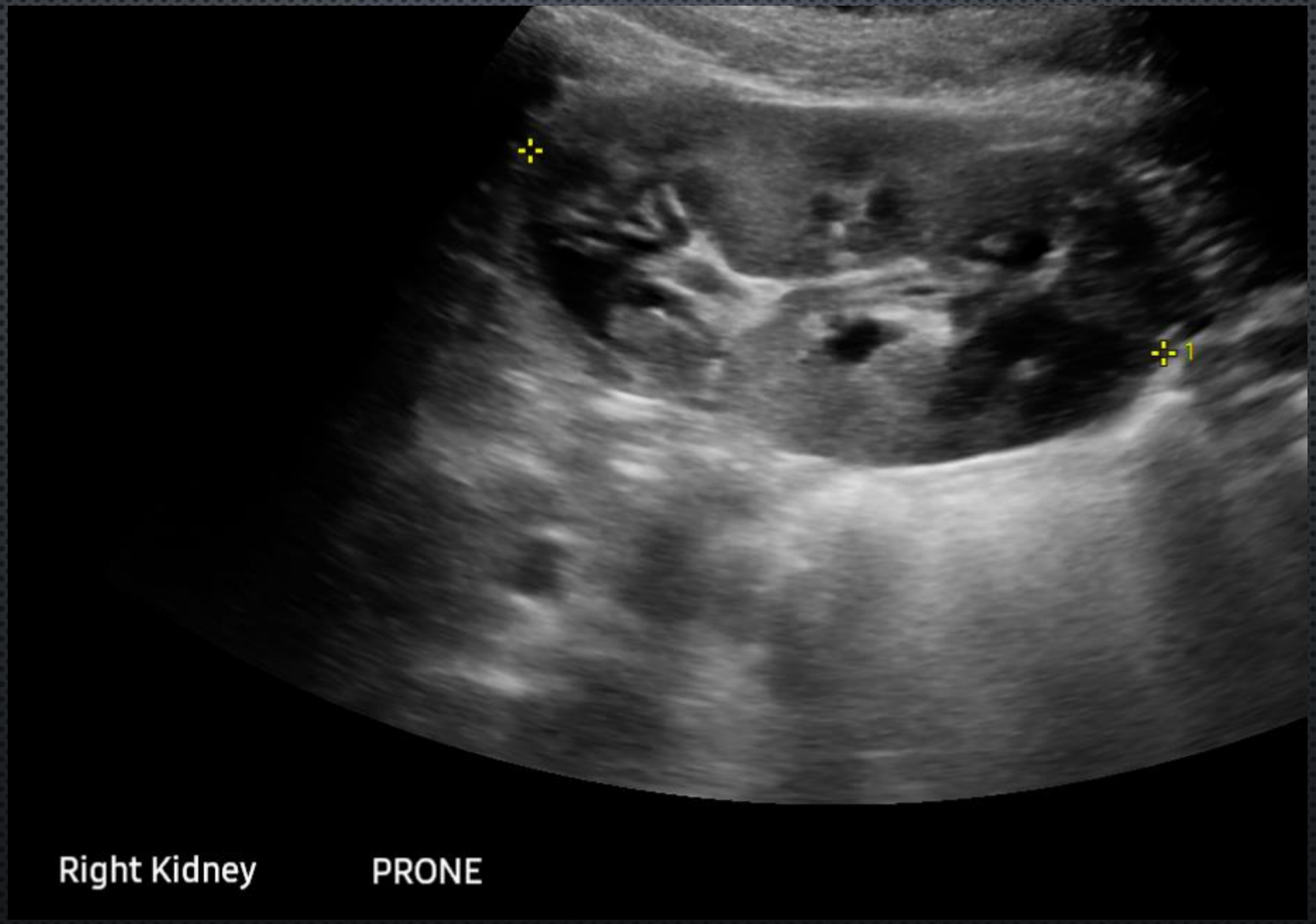
THE LEAKY VESICO-URETERIC JUNCTION :VUR

- NEONATES: DILATED KIDNEY AND URETER
- OFTEN- RECURRENT UTI
- DILATATION MAY BE INTERMITTENT, ABSENT OR MILD

5 YEAR OLD WITH RECURRENT UTI

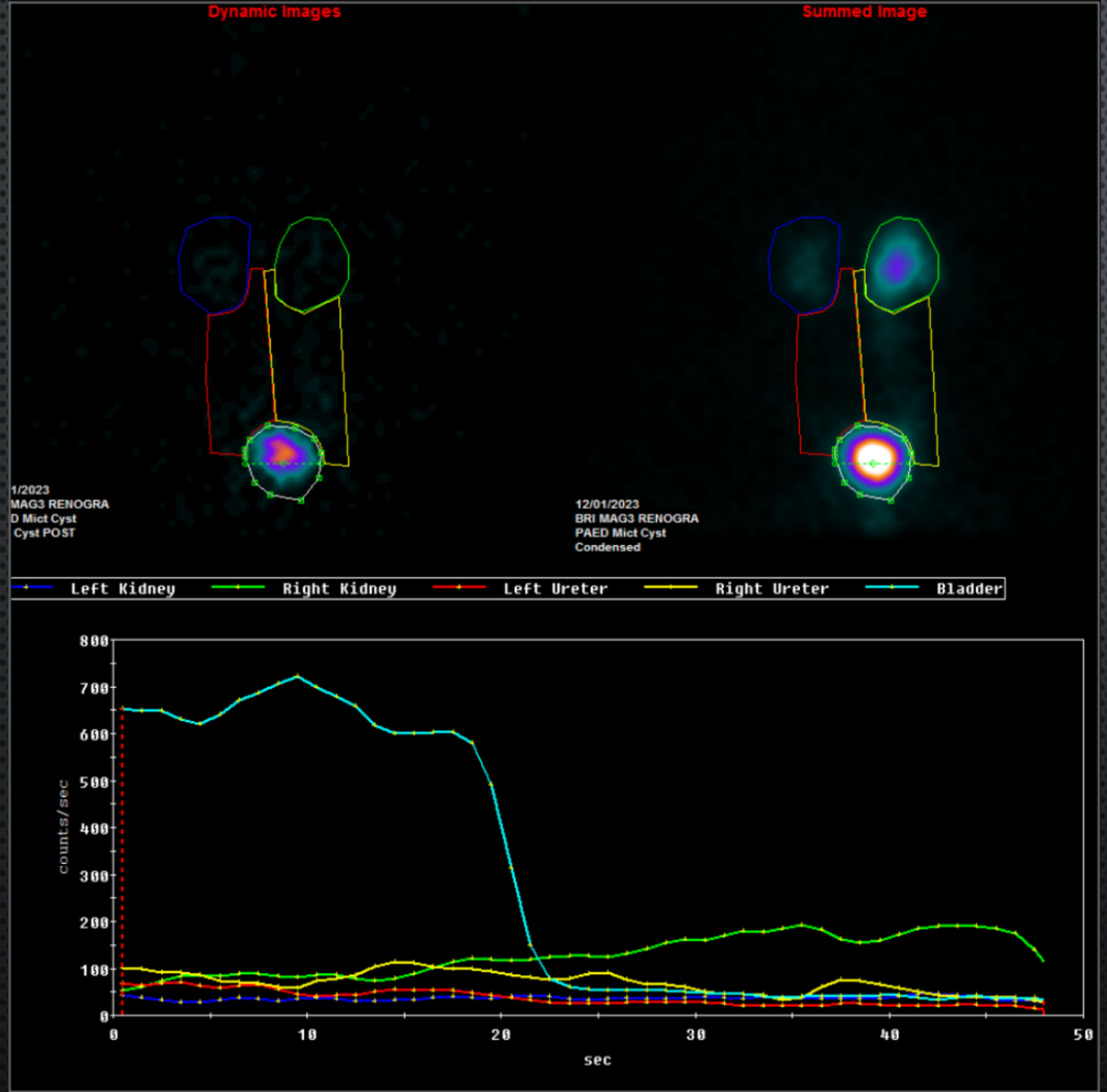


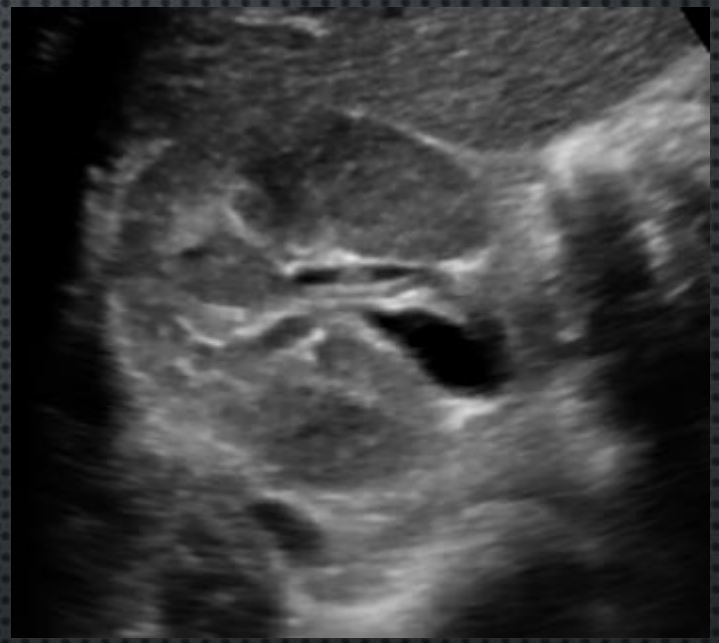

Left Kidney



64 mm

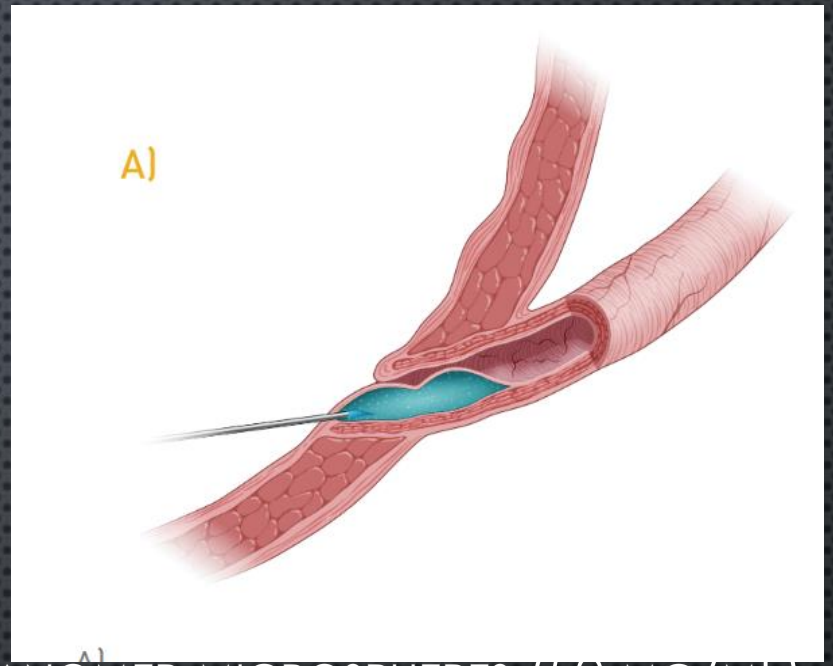
Urothelial thickening, a useful marker


Dynamic Images
Summed Image
1/2023
MAG3 RENOGRA
D Mict Cyst
Cyst POST
12/01/2023
BRI MAG3 RENOGRA
PAED Mict Cyst
Condensed
Left Kidney
Right Kidney
Left Ureter
Right Ureter
Bladder
800
700
600
500
400
300
200
100
0
counts/sec
0
10
20
30
40
50
sec



Treated with Deflux

DEFLUX TREATMENT



- "NASHA/Dx is a sterile, highly viscous gel of dextranomer microspheres (50 mg/mL) in a carrier gel of non-animal stabilized hyaluronic acid (15 mg/mL), constituting a biocompatible and biodegradable implant."

- Deflux.com

Review

Non-Animal Stabilized Hyaluronic Acid/Dextranomer Gel (NASHA/Dx, Deflux) for Endoscopic Treatment of Vesicoureteral Reflux: What Have We Learned Over the Last 20 Years?

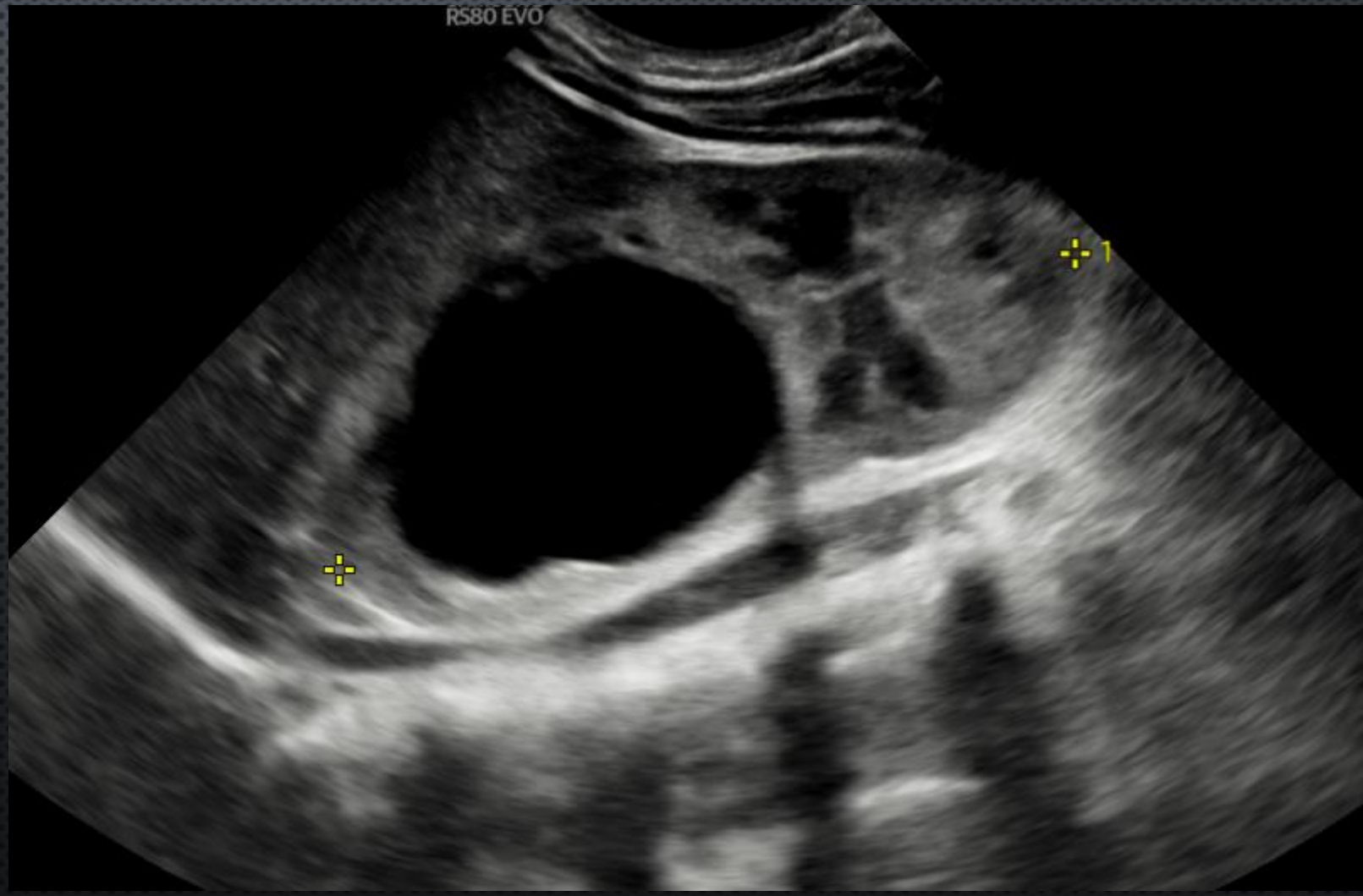
Andrew J. Kirsch, Christopher S. Cooper, and Göran Läckgren

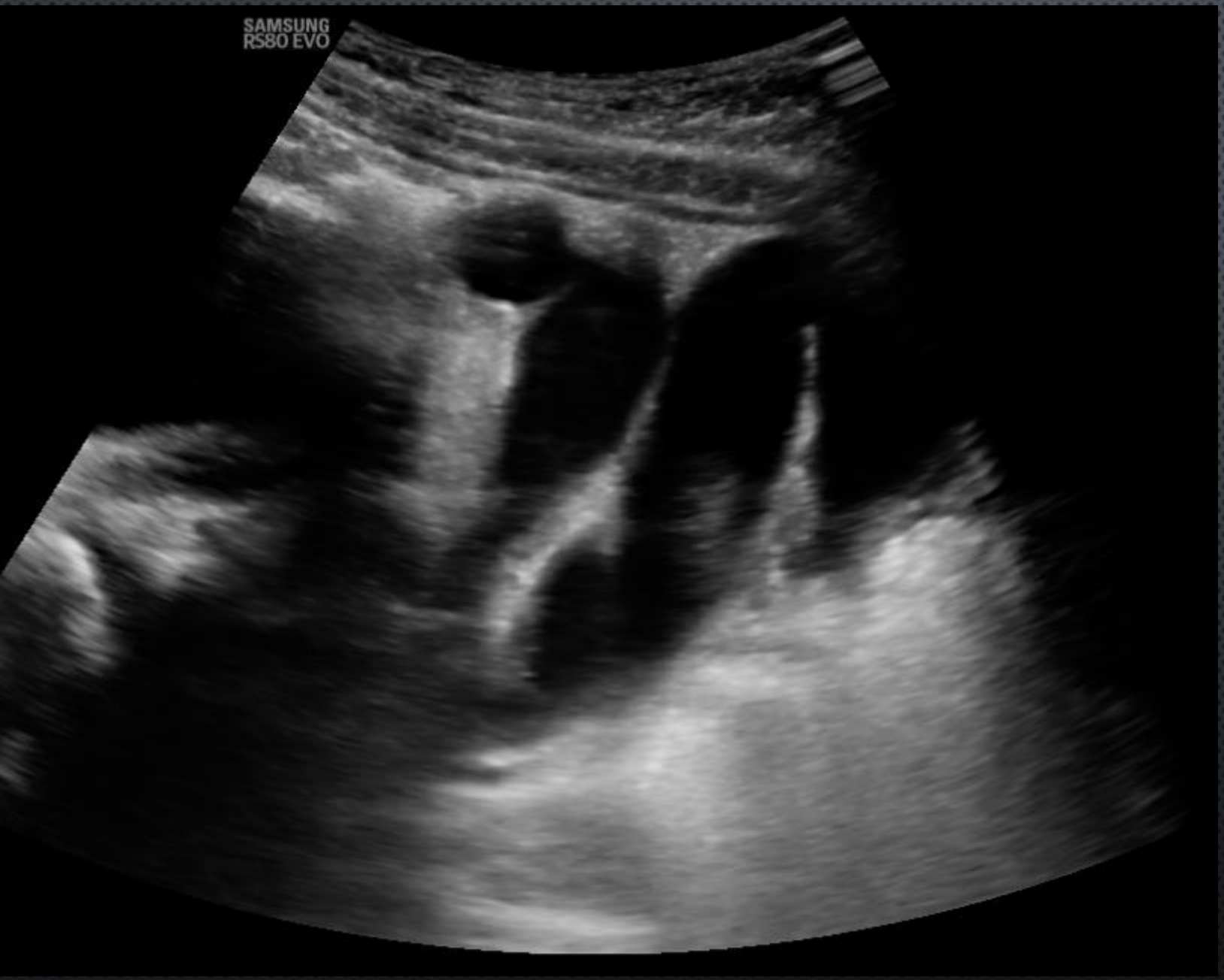
Non-animal stabilized hyaluronic acid/dextranomer gel (Deflux; NASHA/Dx) was developed as a treatment for vesicoureteral reflux (VUR) in the 1990s. To mark 20 years since the US approval of this agent, we reviewed its properties, best practice for application, and the available clinical safety and efficacy data. Long-term or randomized, controlled studies of treatment with NASHA/Dx have reported VUR resolution rates of 59%–100% with low rates of febrile urinary tract infection post-treatment (4%–25%), indicating long-term protection of the kidneys. An individualized approach VUR management is advocated, and NASHA/Dx is a viable option for many patients requiring intervention. UROLOGY 157: 15–28, 2021.

*Look at the vesico-ureteric junction

*Change the depth to allow you to see the pelvic ureters

PARTIALLY DILATED: DUPLEX COMPLICATED



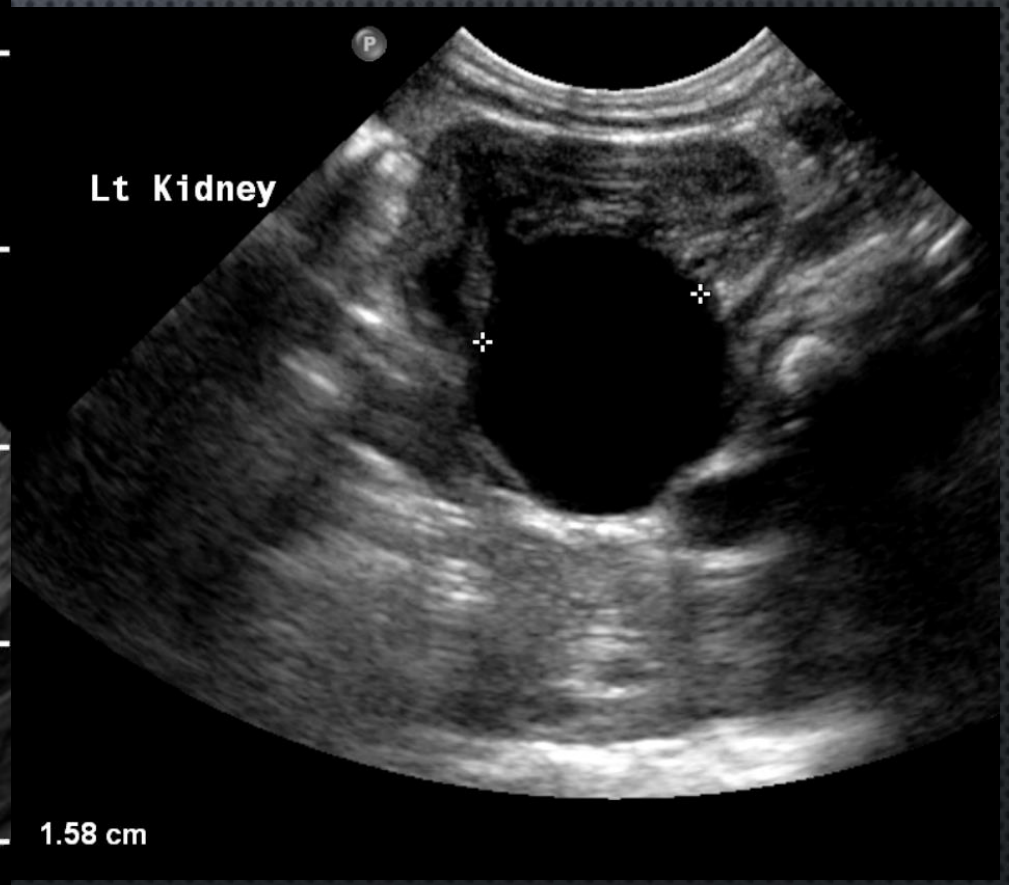


At fluoroscopic MCUG: No vesico-ureteric reflux. Obstruction at VUJ

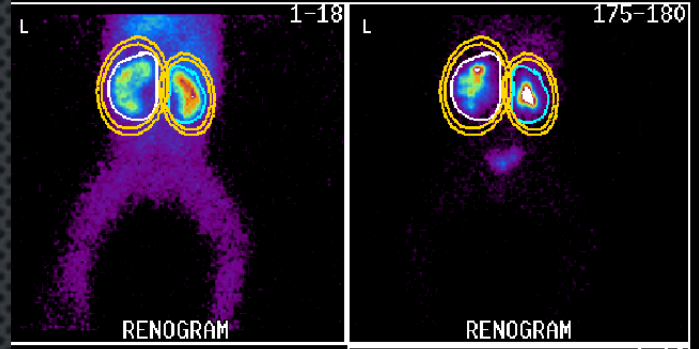
Treatment

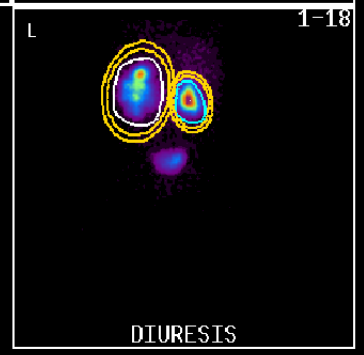
- Treat infection, nephrostomy if necessary
- Elective heminephrectomy and upper moiety ureterectomy

UPPER DILATATION ONLY: PUJO



7 months old





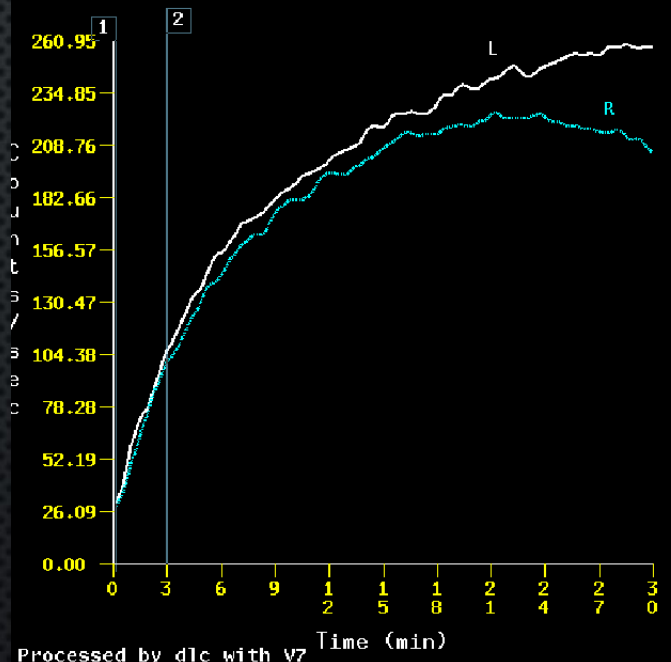
RENOGRAM RESULTS

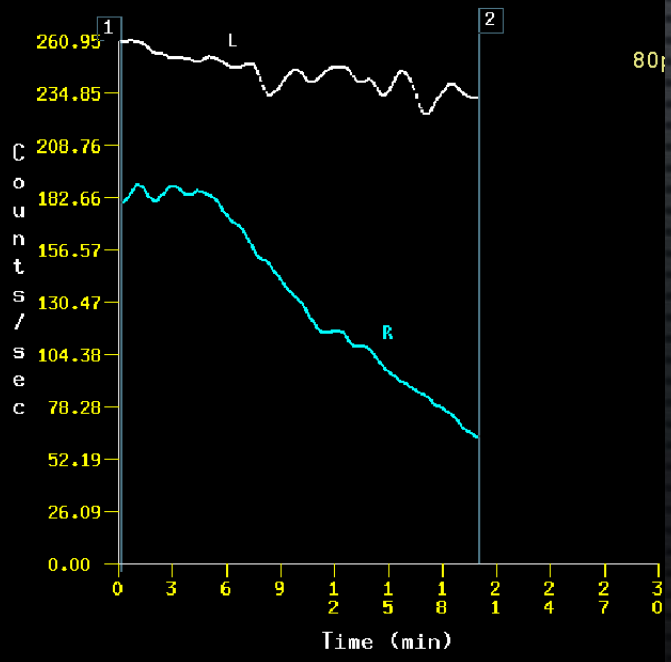
Differential Function
==========

Left 52 %
Right 48 %

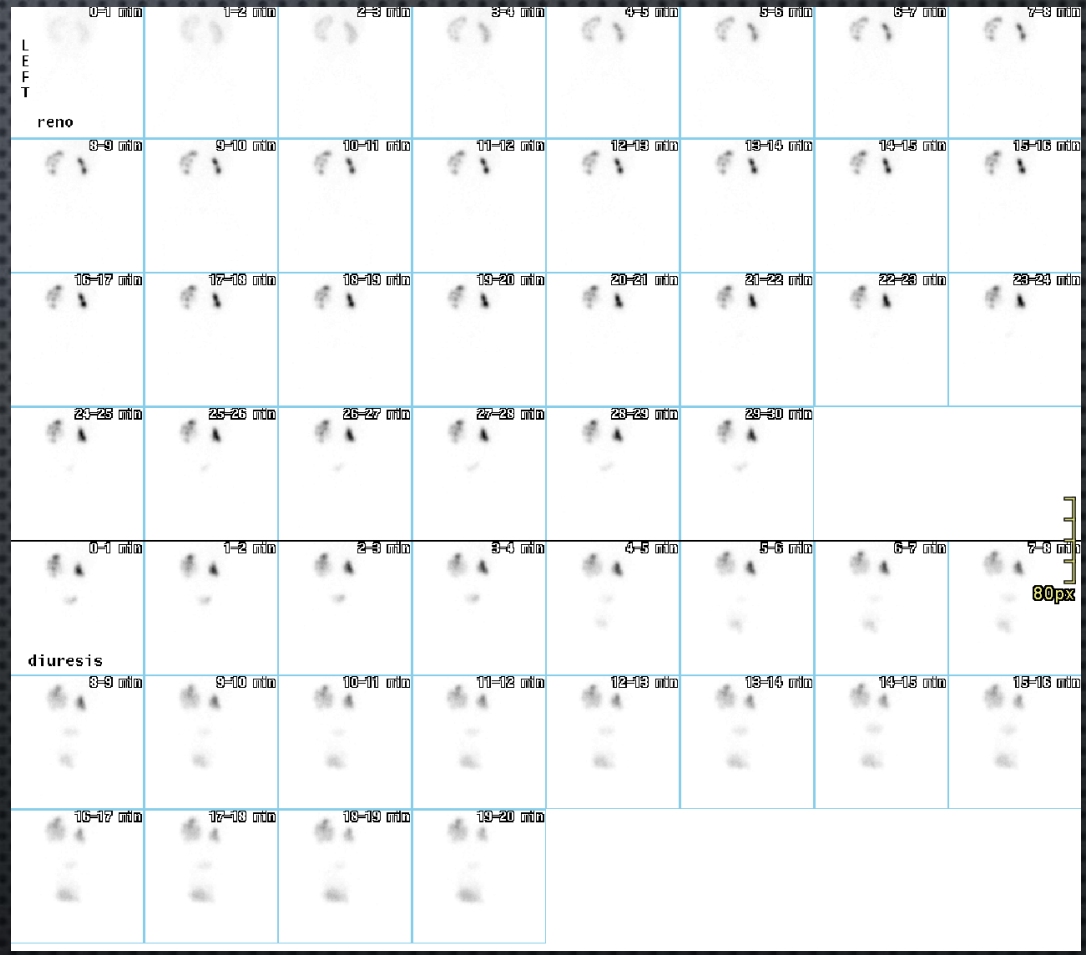
Time to Peak
==========

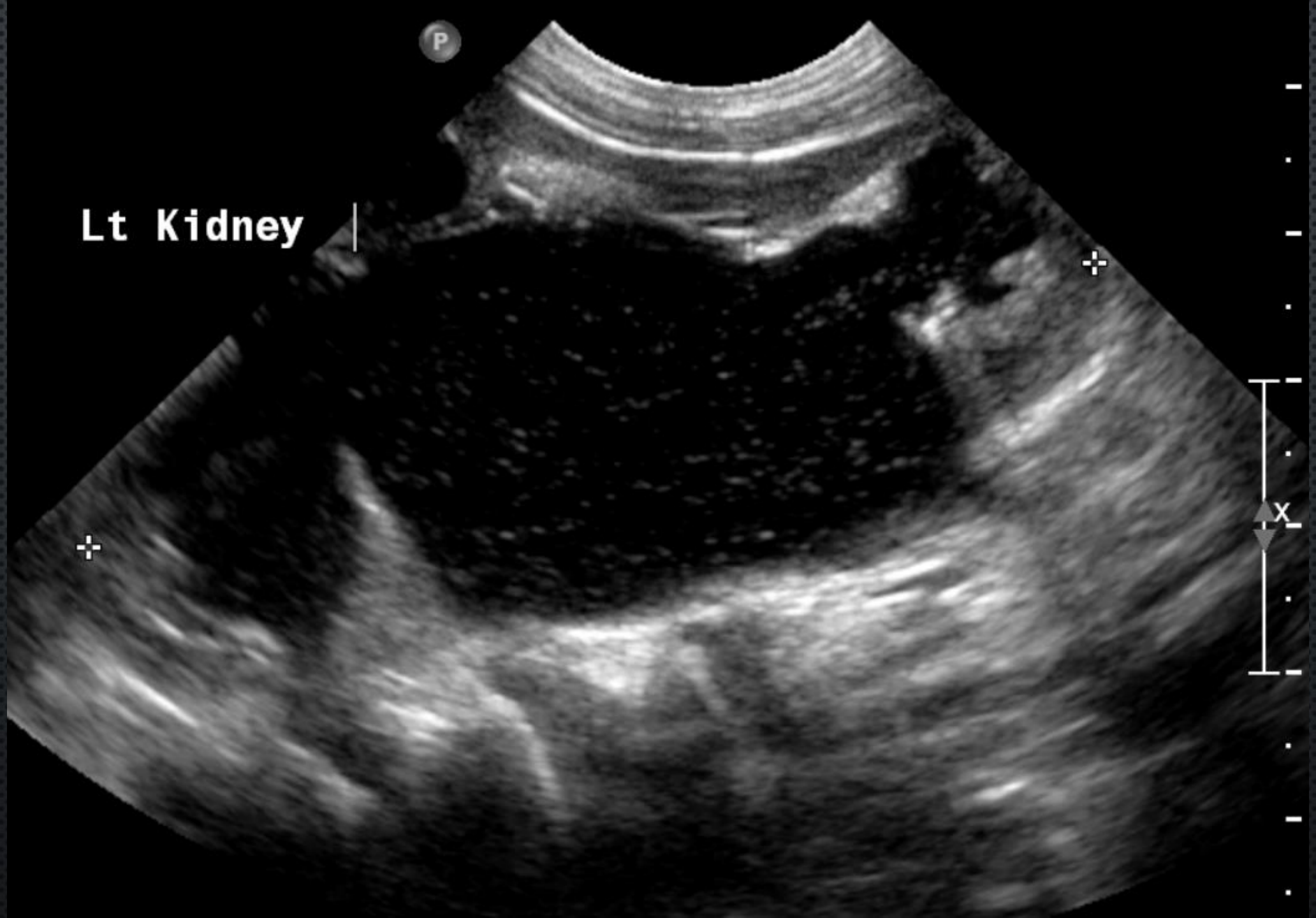
Left 28.50 minutes
Right 23.67 minutes

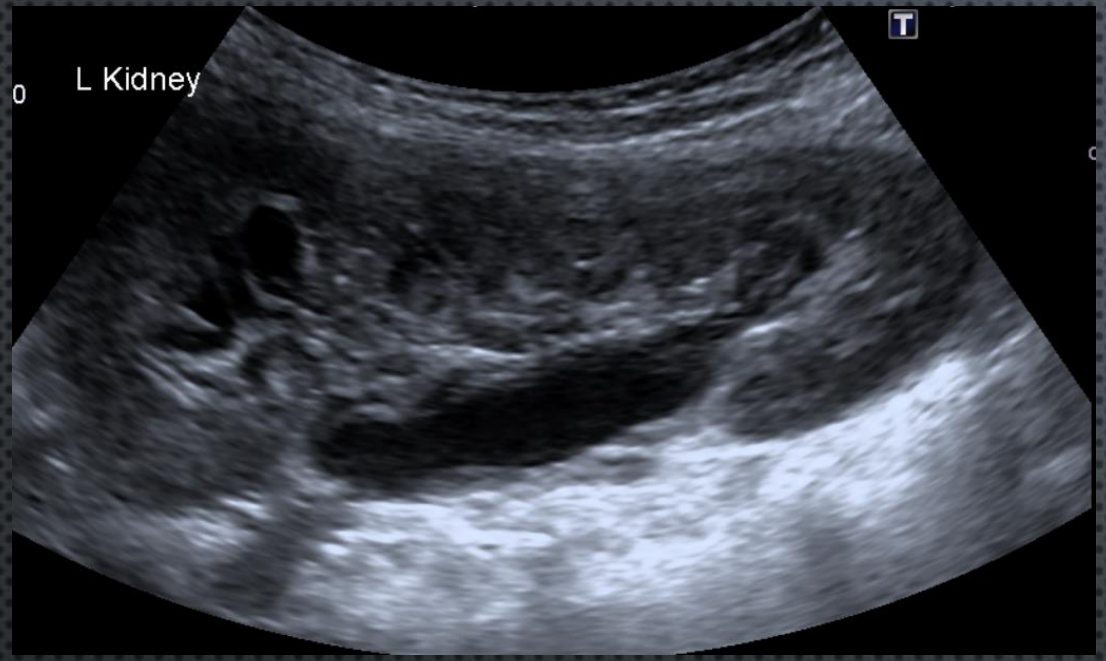


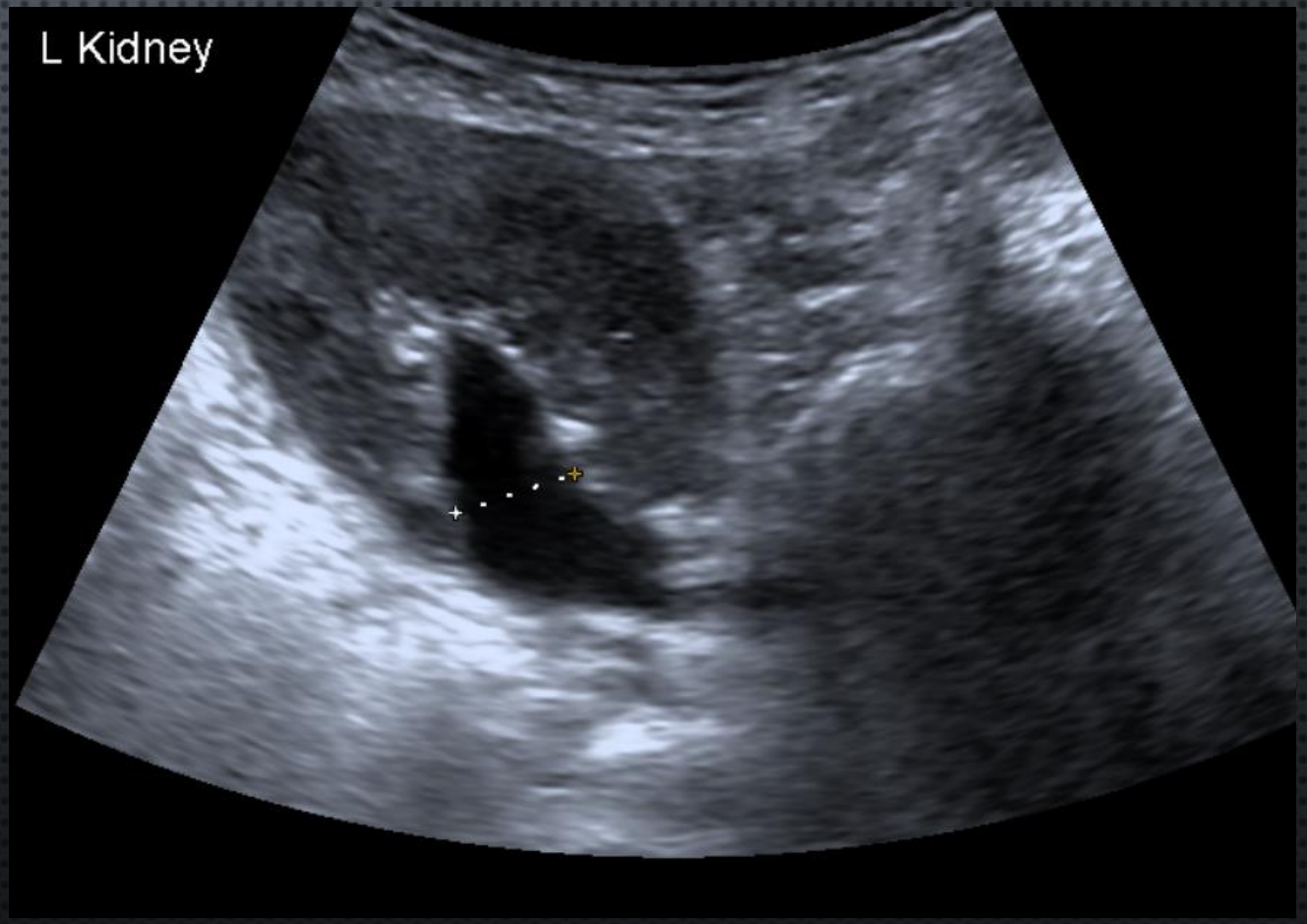


Processed by dlc with V7




Lt Kidney





Post pyeloplasty follow up

WHAT TO LOOK FOR:

- Bladder – filling,wall, voiding
- Ureteric orifices – position, ureterocoele
- Distal ureters dilated?
- Dilated: renal pelvis, central, peripheral calyces
- Transverse intrarenal pelvis diameter
- Urothelial thickening
- Urinary debris or stones
- Parenchyma: echogenicity, thinning, cysts
- Comparison with prior imaging
- Signs of intervention: deflux, ureteric stent, pyeloplasty

Pediatric Radiology (2022) 52:740–751
https://doi.org/10.1007/s00247-021-05263-w

NEONATAL IMAGING

2021 update on the urinary tract dilation (UTD) classification system: clarifications, review of the literature, and practical suggestions

Hiep T. Nguyen[1] · Andrew Phelps[2] · Brian Coley[3] · Kassa Darge[4] · Audrey Rhee[5] · Jeanne S. Chow[6]

Received: 30 March 2021 / Revised: 21 November 2021 / Accepted: 10 December 2021 / Published online: 4 January 2022

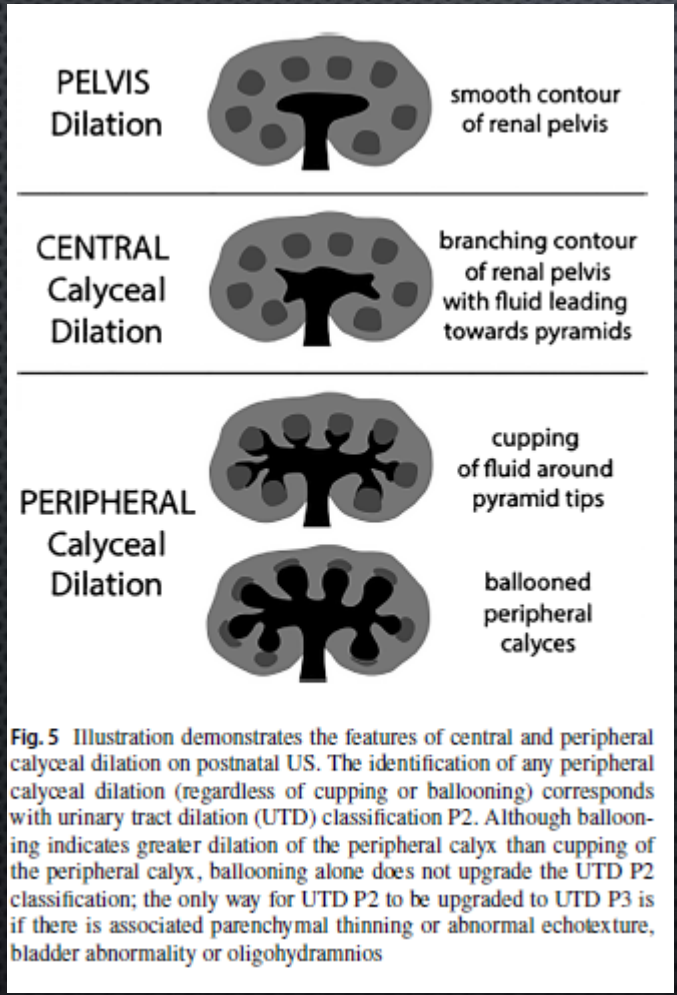


Fig. 5 Illustration demonstrates the features of central and peripheral calyceal dilation on postnatal US. The identification of any peripheral calyceal dilation (regardless of cupping or ballooning) corresponds with urinary tract dilation (UTD) classification P2. Although ballooning indicates greater dilation of the peripheral calyx than cupping of the peripheral calyx, ballooning alone does not upgrade the UTD P2 classification; the only way for UTD P2 to be upgraded to UTD P3 is if there is associated parenchymal thinning or abnormal echotexture, bladder abnormality or oligohydramnios

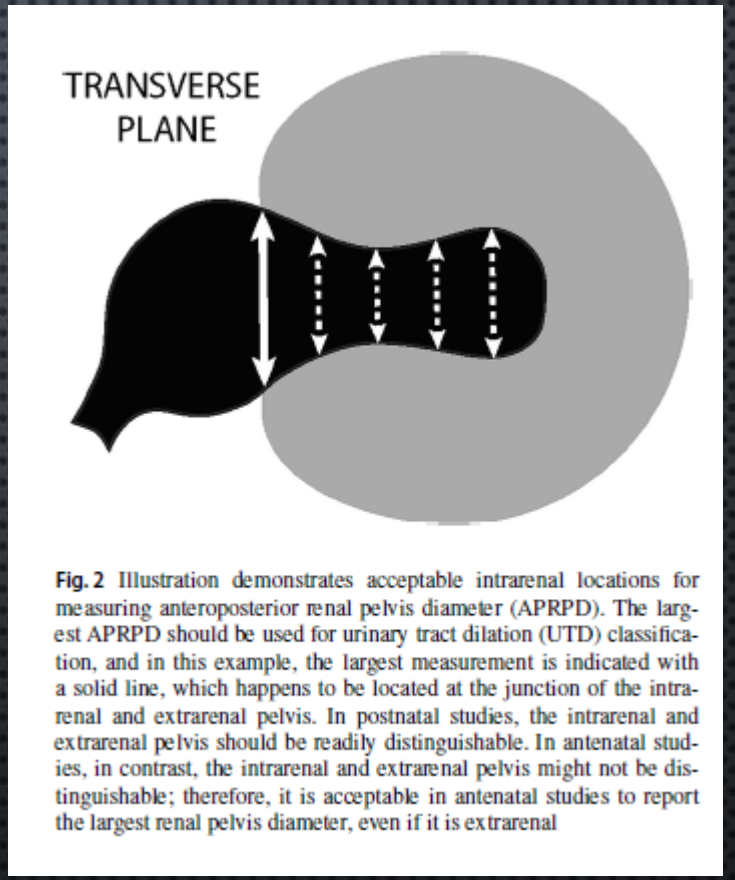


Fig. 2 Illustration demonstrates acceptable intrarenal locations for measuring anteroposterior renal pelvis diameter (APRPD). The largest APRPD should be used for urinary tract dilation (UTD) classification, and in this example, the largest measurement is indicated with a solid line, which happens to be located at the junction of the intrarenal and extrarenal pelvis. In postnatal studies, the intrarenal and extrarenal pelvis should be readily distinguishable. In antenatal studies, in contrast, the intrarenal and extrarenal pelvis might not be distinguishable; therefore, it is acceptable in antenatal studies to report the largest renal pelvis diameter, even if it is extrarenal

CONCLUSION

- ANATOMY RULES
- SIZE MATTERS
- POSITION AND SHAPE
- THE DILATED SYSTEMS
- SYSTEMATIC ANALYSIS