

New Radiation-free Era in Reflux Imaging for Paediatric Urinary Tract Infection (UTI):

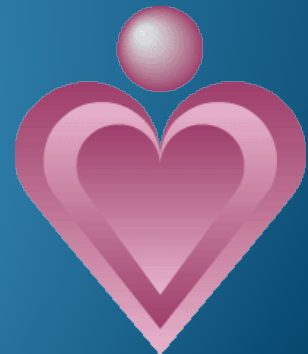
Voiding Urosonography (VUS) with Intravesical Ultrasound Contrast – First Local Pilot Study

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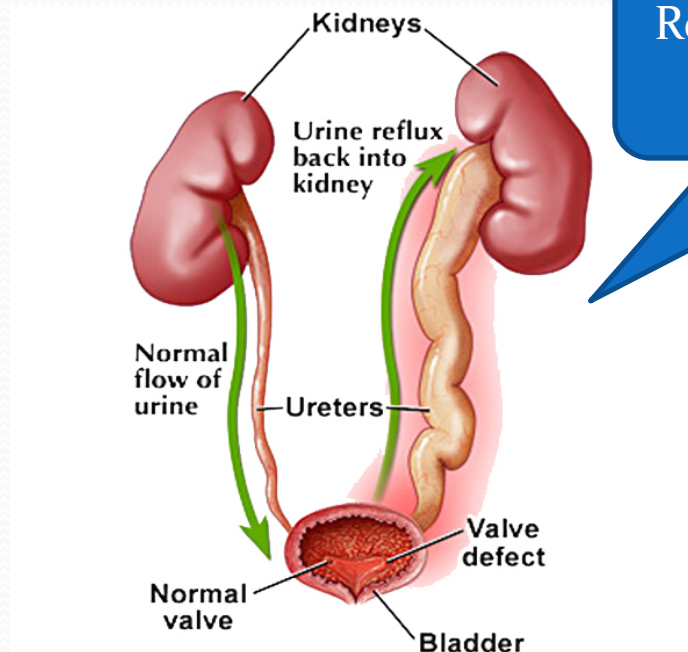


Vesicoureteric Reflux



Vesicoureteric Reflux

- Important cause for childhood urinary tract infection
- Accounts for 25-40% of childhood UTI and 20% of neonatal UTI

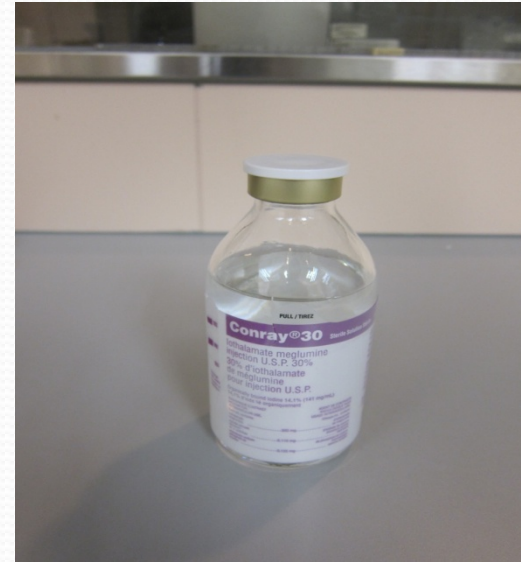


Recurrent pyelonephritis,
Renal scarring

Imaging

Micturating Cystourethrography (MCU)

- Gold standard for VUR for decades
- *Ionizing radiation*
 - More susceptible in *children*



Voiding Urosonography (VUS)

- Sonovue: 2nd generation ultrasound contrast
- **Aqueous suspension** of phospholipid-stablized **microbubbles** of sulphur hexafluoride



Voiding Urosonography (VUS)

- ‘... **safe** and **reliable** ...’ *Riccabona M 2008*
- ‘... **favourable safety profile** ... paediatric application in 5079 examinations’ *Riccabona M 2012*
- ‘... **higher sensitivity** than MCU’ *Darge K 2004*
- ‘... alternative **radiation-free** imaging method ...’
Papadopoulou F 2009
- ‘... **valid alternative** to conventional VCUG or RC ...’
Riccabona M 2008

Our Study

Study Design


- Prospective, comparative study
- September 2010 - August 2012
- KCC Ethic Committee

Study Design

- Recruited subjects
 - Children under 5 years old after first episode of UTI
- Exclusion criteria
 - Active urinary tract infection
 - Known allergy
- Study parameters:
 - Presence and grading of vesicoureteric reflux (Standardized International Reflux Grading System)
 - Duration of examination
 - Complications
 - Reproducibility

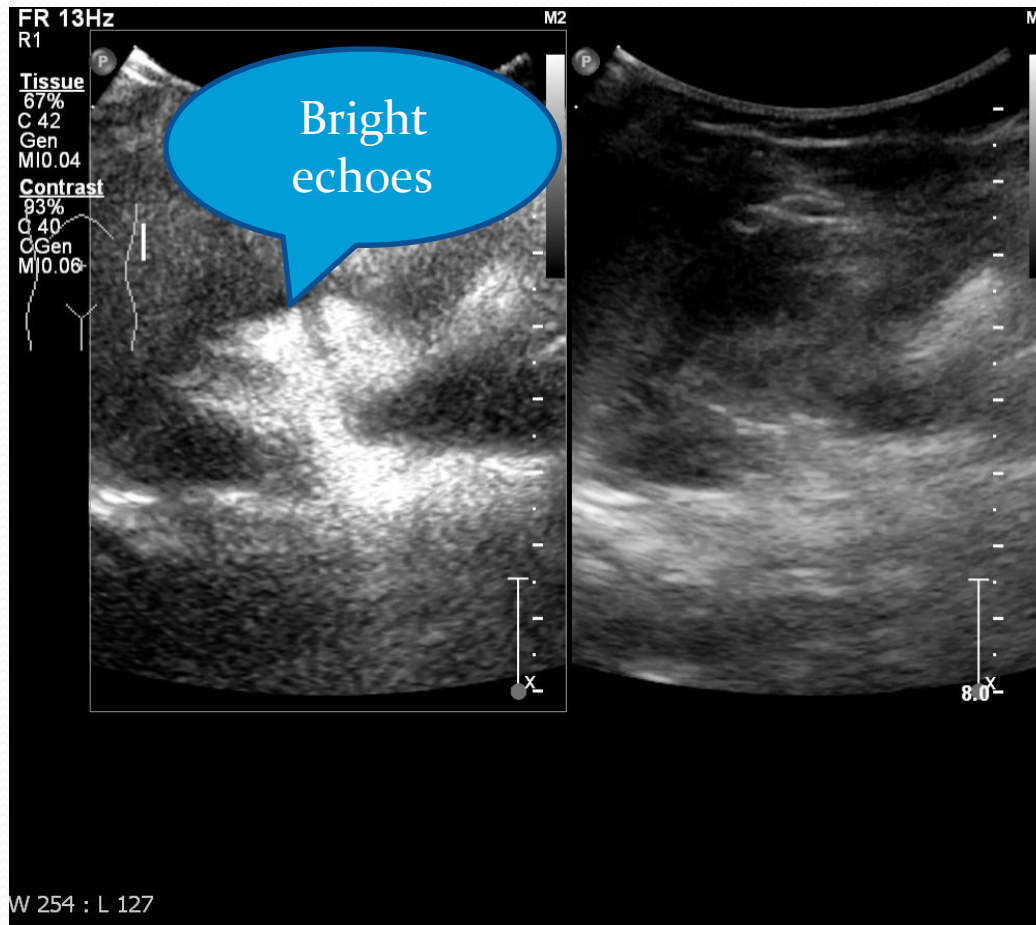
Study Design

- 
- Bladder Catheterization (by paediatrician)

- 
- Diagnostic Ultrasound of urinary tract
 - Voiding Urosonography (by paediatric radiologists and senior sonographer)

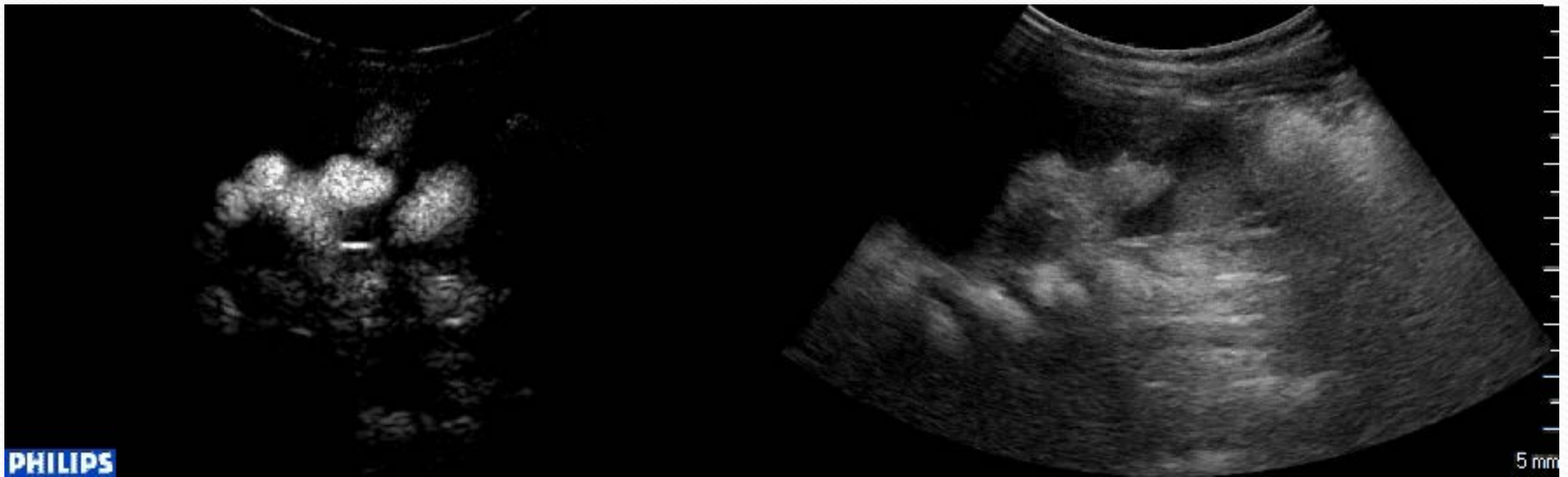
- 
- Micturating Cystourethrography (by another group of senior radiologists)

VUS – Visualization of microbubbles



VUS – Visualization of microbubbles

Moving echoes



MCU – Visualization of contrast



Study design - Reproducibility

- Cohen's Kappa statistics on interobserver agreement
 - On detection and grading of VUR by VUS
- Independent assessment of saved images / cine clips of all VUS studies
 - 6 months after study completion

Results

Results

- 31 patients recruited
- 62 kidney-ureter units (KUUs)

- 23 Males, 8 Females
- Mean age 8.87 months

Results

Reflux Detection

Reflux Grading

Reflux detection by two methods

	MCU (n=62)	VUS (n=62)
Reflux +ve	5	14
Reflux -ve	57	48

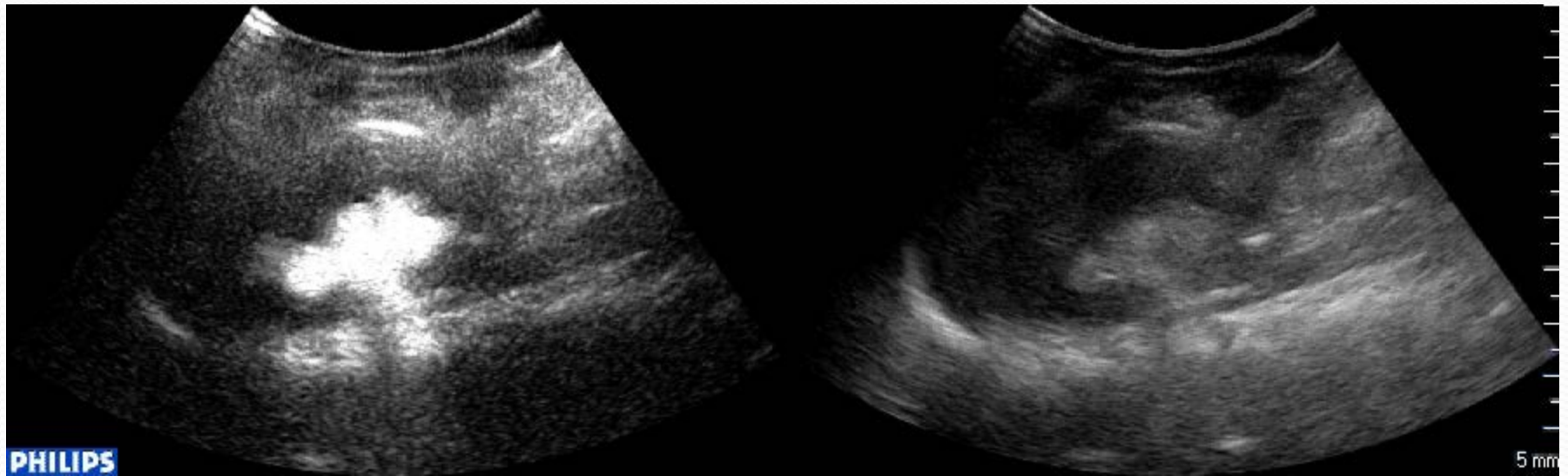
- **Good concordance** (85.5%) based on presence and absence in both methods
- Good agreement in +ve reflux grading (n=5)

Reflux detection by two methods

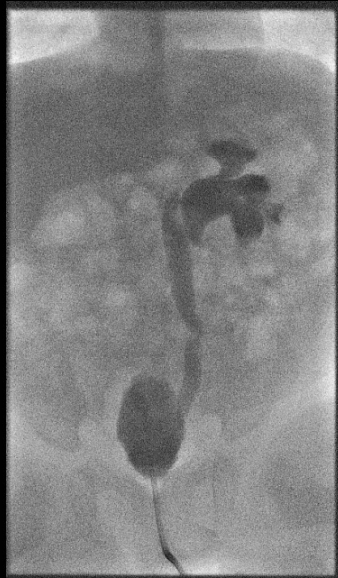
	MCU Reflux +	MCU Reflux -	
VUS Reflux +	5	9	14
VUS Reflux -	0	48	48
	5	57	62

- MCU missed 9 reflux KUUs (High grades + Low grades)
- **Higher detection rate by VUS** than MCU
 - $P < 0.005$ (McNemar's test)

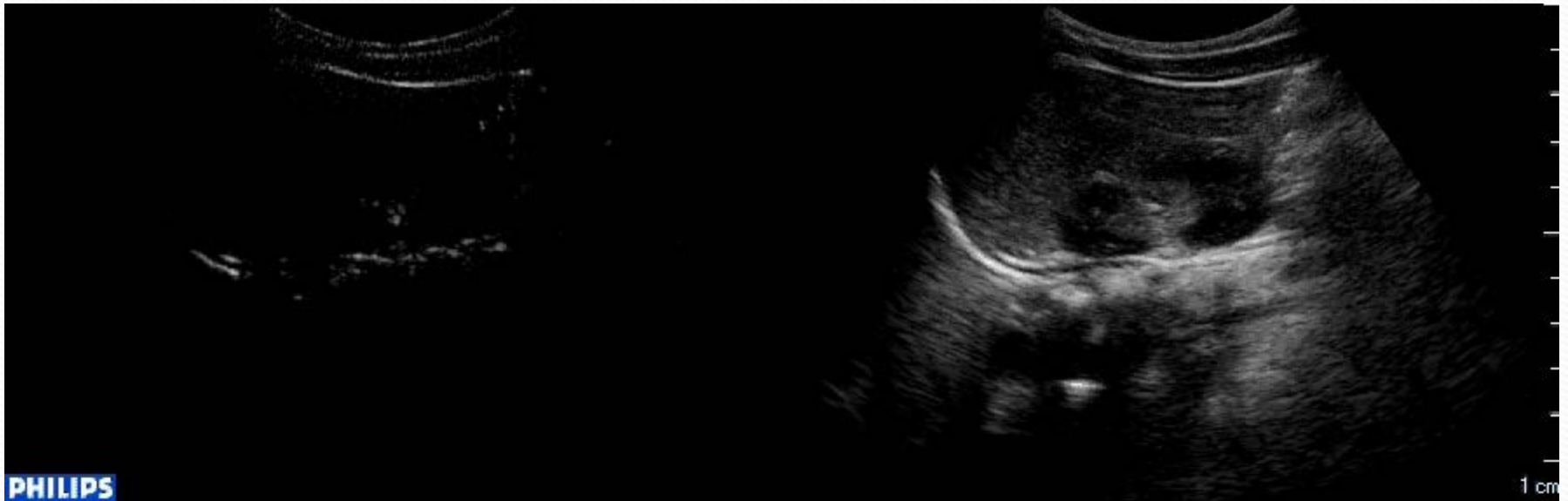
Case 1 - VUS



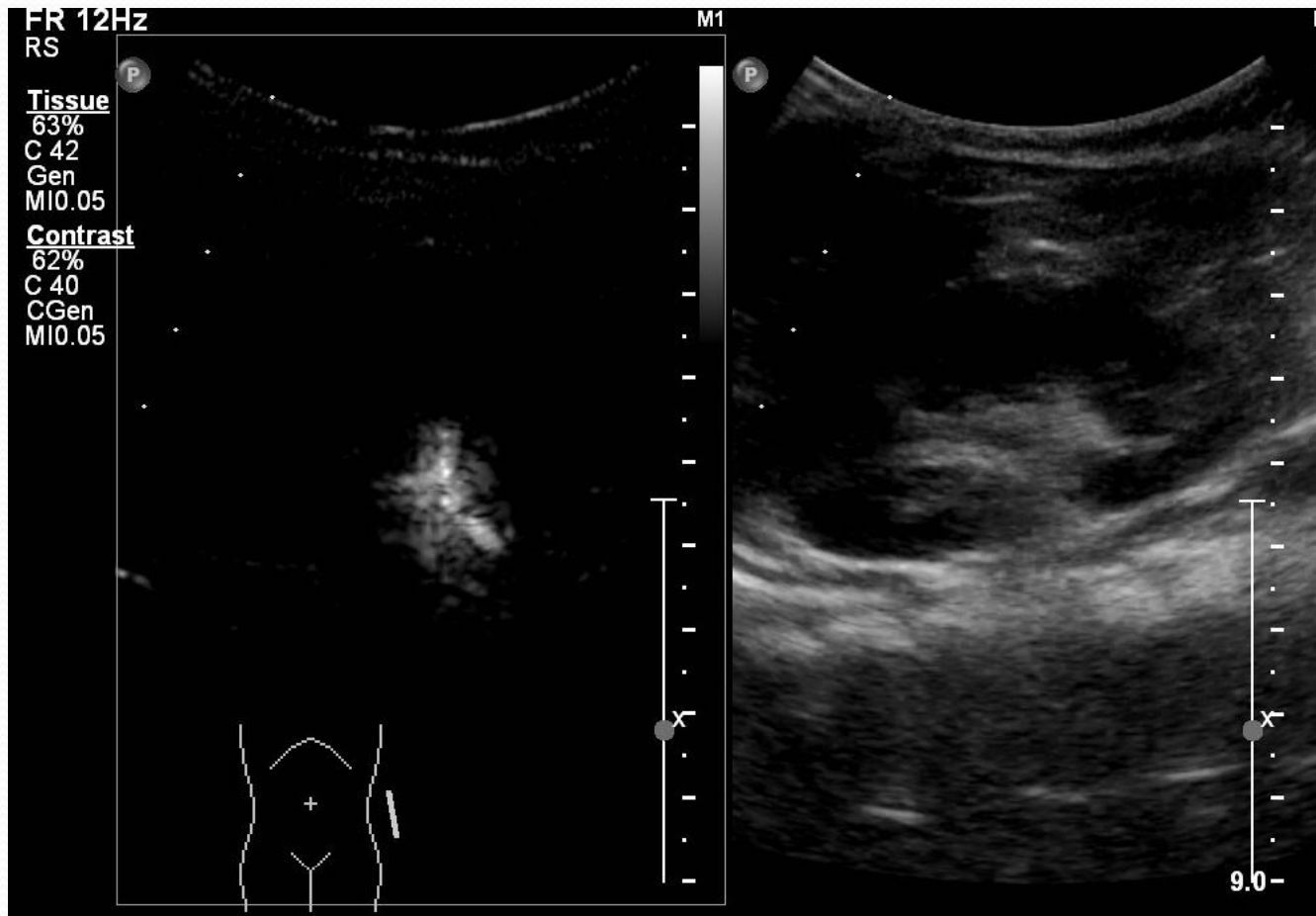
Case 1 - MCU



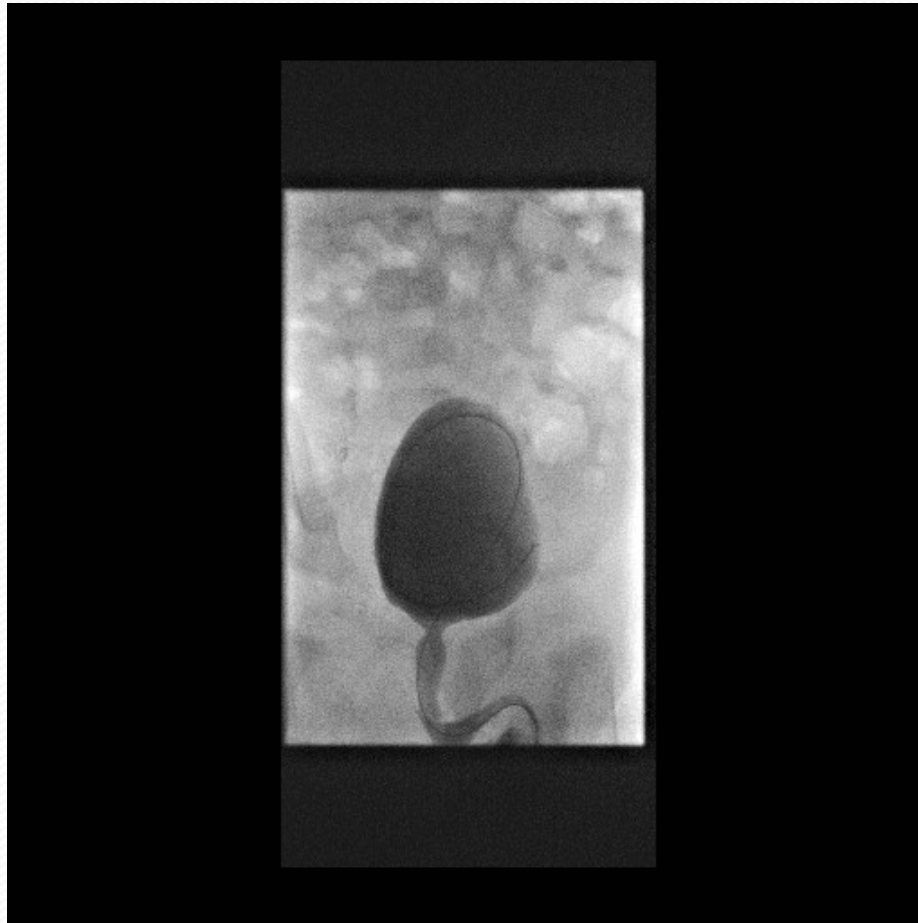
Case 2 – VUS (Right)



Case 2 – VUS (Left)



Case 2 – MCU



Results

Examination Duration

Safety of VUS

Examination duration

	Mean (Minutes)	SD (Minutes)
VUS	11.13	4.90
MCU	12.39	6.91

- No significant difference in examination duration (Wilcoxin signed ranks test)
 - $p=0.277$
 - => *Similar duration*

Safety

- No immediate complications
- No delayed complications up to 72 hours (by phone follow up on Day 3)
- Safe

Results

Interobserver Agreement

Reproducibility

- Independent assessment of saved VUS images
- By two operators

- Cohen's Kappa = 1.0 ($p < 0.05$)
- **Perfect agreement**

The background is a solid blue color. At the top, there are several wavy, overlapping lines in shades of blue and cyan, creating a decorative header effect.

Conclusion

Conclusion

VUS has the following characteristics:

1. Higher detection rate of reflux than MCU
2. Reliable
3. Simple & technically feasible
4. Safe
5. Radiation free
 - *Important to children*

Conclusion

- Can VUS be an alternative to MCU?



Remember :
Posterior Urethral Valve
in boys

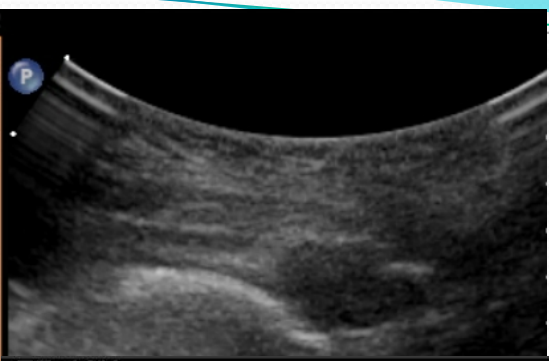
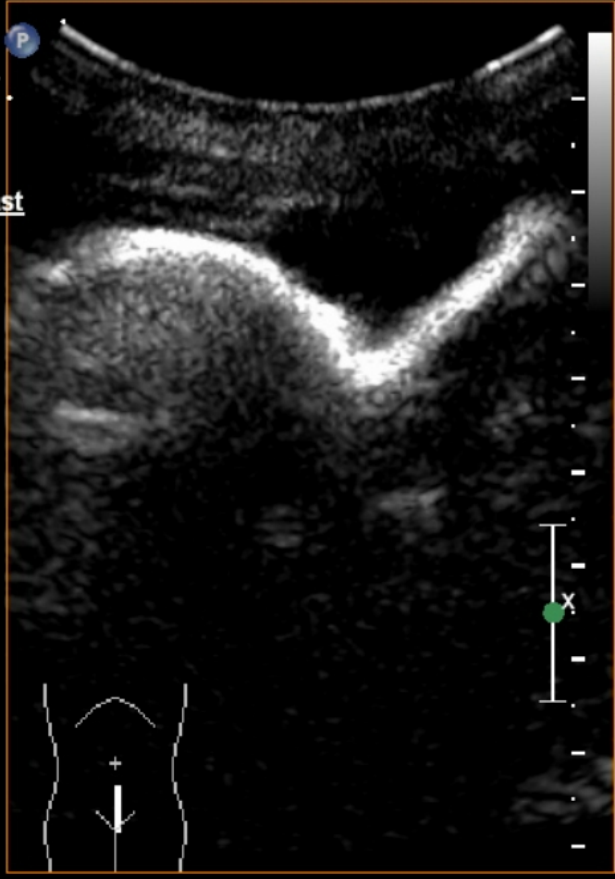
Study of urethra is not
a limitation ... in VUS
(Duran et al 2009)

FR 13Hz
RS

M2

Tissue
64%
C 42
Gen
MI0.05

Contrast
68%
C 40
C Gen
MI0.05



FR 12Hz
RS

M2

Tissue
67%
C 42
Gen
MI0.05

Contrast
67%
C 40
C Gen
MI0.05

3RD



9.0

Implications of our study

VUS = **Alternative** to MCU

VUS = **One-stop** examination with US of urinary tract

- Save time and resources

VUS = **Future trend** in reflux imaging

- Cluster Technology Committee in KCC
- Adopted in KCC this year

References

1. Kis E, Nyitrai A, Varkonyi I, Mattyus I, Cseprekal O, Reusz G, Szabo A. Voiding Urosonography with Second-generation Contrast Agent Versus Voiding Cystourethrography. *Pediatr Nephrol* 2010;25:2289-2293
2. Papadopoulou F, Anthopoulou A, Siomou E, Efremdis S, Tsamboulas C, Darge K. Harmonic Voiding Urosonography with a second-generation contrast agent for the diagnosis of vesicoureteral reflux. *Pediatr Radiol* 2009;39:239-244
3. Lim R. Vesicoureteral Reflux and Urinary Tract Infection: Evolving Practices and Current Controversies in Pediatric Imaging. *AJR* 2009;192:1197-1208
4. Routh JC, Lee RS, Chow JS. Letters to Editor: Radiation Dose and Screening for Vesicoureteral Reflux. DOI:10.2214/AJR.09.3384
5. Duran C, Valera A, Alguersuari A, Ballesteros E, Riera L, Martin C, Puig J. Voiding urosonography: the study of the urethra is no longer a limitation of the technique. *Pediatr Radiol* 2009;59:124-131

Remarks

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End