Purpose

Vesico-urinary reflux (VUR) is the most common congenital urinary tract anomaly. It presents in 25% to 40% of children with repeat cases of urinary tract infection (UTI) and may cause renal scarring, particularly in patients with the severe form. Renal insufficiency and arterial hypertension is associated with renal damage caused by VUR and UTI in children. It is important to detect VUR before the onset of infection to prevent such complications.

- Disadvantages of VCUG:

1- Radiation exposure to the gonads; so there is always a chance of cancer from radiation. The effective radiation dose from this procedure is about 1.6 mSv, which is about the same as the average person receives from natural background radiation in 6 months. This dose for infant is about 0.8 mSv.

2- Urethral catheterization which induces fear, distress and pain in the patients and their parents. Experience of discomfort when the catheter inserted, remain till days after procedure that caused disability to urination.

3- VCUG is associated with a risk of iatrogenic urinary tract infection. VCUG should not be performed while an active, untreated urinary tract infection is present.

- The method used in this study (MRVCUG) is advantageous because

1- It requires no ionizing radiation or invasive bladder catheterization, which can be painful and frightening for small children and distressing for their parents.

2- Reducing radiation exposure to the gonads from diagnostic imaging is particularly important for pediatric patients with VUR

3- Omitting the risk of induced UTI through catheterization and diminishing stress of patient and their parents could be a significant benefit of MRVCUG.

4- In addition filling of bladder spontaneously with hydration has more sensitivity in MRVCUG rather than manual filling of bladder through catheter in high pressure.

In this study we wanted to show that MRVCUG can be an alternative for VCUG, which does not have disadvantages of VCUG and catheterization.
Methods and Materials

This study was done during 2006 to 2008 in Al-Zahra hospital, Esfahan University of medical sciences.

- Type of study: Cross sectional
- Sample population in our study:

INCLUSION CRITERIA

1. First time UTI in every child younger than 5 years old.
2. UTI in Male in any age group.
4. Febrile UTI in any age.

# Every patient who have urinary control and have one of above criteria.

EXCLUSION CRITERIA

If early voiding occurs or agitation of patient cannot be controlled, it was omitted from the sample and was replaced with another patient.

- Sampling: Convenience simple sampling

1. All patients underwent VCUG and MRVCUG within a period of less than one to two months.
2. VCUGs were done in the center of FARHANGIAN by referring of pediatric nephrologist.
3. At the time of MRVCUG studies, radiologist was not aware of the result of the VCUG
4. The patient was well hydrated
5. If needed, mild sedation with Chloral hydrate was done under supervision of pediatrician.

6. The children were asked to drink water before the examination until they had a full-bladder sensation.

7. Subsequent to the scout image acquisition, 1 mg/kg Furosemide was been administered (IM).

8. In patients, a disposable diaper will use for the examination.

9. The lower part of patients will be examined in the supine position in a 1.5-T scanner.

10. A body coil was used for the other patients.

11. MRI was executed with a non-enhanced heavily T2-Weighted single-shot fast spin echo (FSE)

12. Sequence with thick-slab acquisitions (50-100 mm, matrix = 256*224).

13. The imaging time was less than two seconds per image.

14. After IM administration of a bolus of 1 mg/kg furosemide, images was obtained every 10 seconds until the urinary bladder expanded and the internal urethral orifice of the urinary bladder dilated.

15. Images were be then obtained every three seconds during urination.

16. The MR images were displayed as cine loops for evaluation.

17. The diagnosis of VUR by MRVCUG was positive when dilation of the ureter or renal pelvic on maturation was observed.

18. The beginning of micturation was defined as the beginning of shrinking of the urinary bladder on the MR images.

19. Also we added additional view as "oblique or para-sagittal view " to observe the orifice of ureters and determined whether ureter is dilated or refluxed according to their shape of distal end.
Results

- Statistical results have been shown in figures 1-5.
- The preparation and imaging procedures were well tolerated by all subjects except one.
- Adequate distention of the urinary bladder was obtained and micturation in the supine position was achieved.
- The mean examination time was 45-60 minutes.
- According standard VCUG findings.
- The sensitivity and specificity of MRVCUG by kidney-ureter units were 92.6% and 68.4%, respectively.
- Agreement regarding the presence or absence of VUR by kidney-ureter units between MRVCUG and VCUG was 93% (k: 0.541).

Regarding the assessment of severity of VUR, a high level of agreement was achieved between MRVCUG and VCUG.
Fig. 0

© Radiology, Image Processing and Signal Research center, Isfahan University of Medical Sciences - Isfahan/IR
Fig. 0

© Radiology, Image Processing and Signal Research center, Isfahan University of Medical Sciences - Isfahan/IR
### MRVCUG vs VCUG

<table>
<thead>
<tr>
<th>MRVCUG</th>
<th>NORMAL</th>
<th>GRADE 1</th>
<th>GRADE 2</th>
<th>GRADE 3</th>
<th>GRADE 4</th>
<th>GRADE 5</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>13</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Mild</td>
<td>6</td>
<td>10</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>19</td>
<td>14</td>
<td>11</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>60</td>
</tr>
</tbody>
</table>

**Fig. 0**

© Radiology, Image Processing and Signal Research center, Isfahan University of Medical Sciences - Isfahan/IR
Fig. 0

© Radiology, Image Processing and Signal Research center, Isfahan University of Medical Sciences - Isfahan/IR
Fig. 0

© Radiology, Image Processing and Signal Research center, Isfahan University of Medical Sciences - Isfahan/IR
Conclusion

- Our study showed that MRVCUG has the ability to demonstrate the presence and severity of high-grade (grade III-V reflux) VURs; However, we should note the limitations of MRVCUG as following:

First, the need for sedation when examining young children is unavoidable.

Second, the relatively long examination time required for MRVCUG may impose a heavy work load on the MR equipment

Third, increased ureteral flow due to hydration and the use of diuretic may confuse the detection of VUR.

Although further studies are required, in the clinical setting, MRVCUG can be used to detect possible surgical candidates among patients with VUR, and to monitor patients.
References


9) MR based imaging shows value in pediatric population ,Erin H.GOLDEN.PHD 2007

10) Magnetic Resonance Voiding Cystourethrography for Vesicoureteral Reflux, Ryutaro Takazakura, MD,1* Kazuyoshi Johnin, MD,2 Akira Furukawa, MD,1Norihisa Nitta, MD,1 Masashi Takahashi, MD,1 Yusaku Okada, MD,2007

magnetic resonance fluoroscopy used as micturating
cystourethrography: experiences in adult male patients. Invest Radiol
in adult normal males. Magn Reson Imaging 1992;10:
881-885.
resonance imaging for the evaluation of hydronephrosis, reflux and
cystography in the diagnosis of vesicoureteral reflux: comparative
study with voiding cystourethrography. J Magn Reson Imaging
15. Phillips D, Watson AR, Collier J. Distress and radiological investigations
684-687.
16. Nuutinen M, Uhari M. Recurrence and follow-up after urinary tract
65:78-80.
18. Elder JS, Longenecker R. Premedication with oral midazolam for
voiding cystourethrography in children: safety and efficacy. AJR