Vesicoureteric reflux and renal scars in asymptomatic siblings of children with reflux

Rajko B Kenda, Jurij J Fettich

Abstract
The purpose of the study was to determine the incidence of vesicoureteric reflux (VUR), renal scars and hypertension in asymptomatic siblings of children with VUR. The study comprised 105 siblings of patients with VUR. Their age ranged from 4 months to 6.3 years. All had a direct radionuclide voiding cystography (DRVC) performed, and VUR was detected in 47 of 105 (45%). High grade VUR in the first year of life had an incidence of 50% compared with a 9% incidence in siblings older than 2 years, while only one of the 27 siblings with a low VUR grade was younger than 1 year. In 43 of 47 siblings with VUR, a technetium-99m dimercaptosuccinic acid (99mTc-DMSA) scan was performed and renal scars were found in 10, which presents 23% of siblings with VUR who were scanned and 10% of all siblings studied. One child had hypertension. Identifying VUR among asymptomatic siblings could possibly prevent renal damage and its consequences. Thus, the predictive value of positive family history alone in identifying VUR was 45% while 23% of siblings had renal scars. This incidence justifies the routine investigation of asymptomatic siblings, by using DRVC at an early stage.

Vesicoureteric reflux (VUR) is the most common abnormality detected in children with urinary tract infection (UTI). According to different authors, it is present in 22% to 52% of the children studied. On the other hand, the incidence has been estimated to be 1% to 2% in the general population. The rationale of detecting VUR is that by close follow up and/or either surgical or conservative treatment, the risk of renal damage (scarring) and its consequences due to the VUR itself, or to the VUR with associated UTI may be minimised.

The incidence of VUR among siblings (even asymptomatic) of children with known VUR is as high as 45%. However, it was not until direct radionuclide voiding cystography (DRVC) with its low radiation exposure was routinely used that VUR detection in siblings became a more widely accepted procedure. Because VUR is normally detected after the UTI, little is known about the natural history of sterile VUR in children and there has not been sufficient data regarding their renal status (scars, hypertension) to recommend screening for VUR routinely. It is known from experimental studies in animals that high pressure reflux can produce renal damage.

The purpose of this study was to determine the incidence of VUR in asymptomatic siblings under the age of 6 of patients with VUR and to determine the incidence of renal scars and hypertension in asymptomatic siblings with proved VUR. The results might justify a recommendation to look for VUR in young siblings.

Patients and methods
One hundred and five siblings of patients with known VUR were admitted to the study from July 1987 to June 1991 inclusive. In 90 families one sibling was evaluated. Two siblings were studied in six families and three in one family. There were 56 (53%) boys and 49 (47%) girls. The age of the siblings ranged from 4 months to 6.3 years (mean age 3.3 years). Fourteen (13%) children were younger than 1 year, 24 (23%) were between 1 and 2 years, while 67 (64%) were older than 2 years. They all had a negative history of UTI and, at the time of admission, they were all free of symptoms.

All children had a DRVC performed and VUR was found in 47 (only a 4 month old boy had a x ray cystogram instead of DRVC). Of 47 children with VUR, 43 also had technetium-99m dimercaptosuccinic acid (99mTc-DMSA) scintigraphy done (in four patients with VUR grade I parental permission for DMSA scintigraphy could not be obtained). The results were reviewed by two independent observers. In cases where there was disagreement, a consensus was reached.

For statistical analyses the χ², Student’s t test, Jonckheere-Terpstra test, and linear by linear association test (StatXact software by Cytel Software Company) were used.

TECHNIQUE OF DIRECT VOIDING RADIONUCLIDE CYSTOGRAPHY
Children were catheterised under aseptic conditions. 99mTc as sodium pertechnetate was added to sterile isotonic saline in concentrations of 40–80 MBq/l. The bladder was slowly filled with the radiotracer solution under hydrostatic pressure (40–60 cm H₂O). When bladder capacity was reached, or when the child showed the urge to void, the catheter was removed, and the voiding usually began within a short period of time. Since 1990 a cyclic DRVC (filling the bladder and having the infant void around the catheter two or three times) has been used instead of conventional DRVC to increase the accuracy of the procedure. A computerised gamma camera (General Electric Maxi Camera 300, computer Digital PDP 11/34) was used to
allow simultaneous visualisation of the radiotracer and to record data at a rate of 1 frame/5 seconds. Data were reviewed with image enhancement by decreasing the upper threshold to 20-30% of maximal radioactivity in the bladder. All children received co-trimoxazole (Bactrim) 6 mg/kg divided into two doses for three days to prevent UTI after catheterisation.

VUR was classified as unilateral or bilateral. According to its extent it was graded as: VUR 1, radiotracer reaching the ureter only; VUR 2, radiotracer reaching the pelvis; and VUR 3, radiotracer reaching the pelvis, which seemed dilated.

**TECHNIQUE OF **\(^{99m}\text{Tc}-\text{DMSA SCINTIGRAPHY}\)

DMSA scintigraphy was performed two hours after the injection of \(^{99m}\text{Tc}-\text{DMSA}. \) The dose was adjusted for the child's height and weight. One posterior and two posterior oblique images containing 300 000 counts each were obtained with a gamma camera (Siemens Basicam ZLC Digitrac 75) and a low energy all purpose collimator, using an appropriate zoom. The relative contribution of each kidney to the global renal function was calculated using a computer image in posterior projection. DMSA scans were considered to be abnormal if there were focal or generalised scars, or if unilateral function was less than 45% of total glomerular filtration.

**Results**

Comparing index children and siblings, no significant difference was found in terms of sex ratio (p=0.4), nor was such a difference found between the sex of index children and VUR grade of siblings (p=0.4). There was no significant association between VUR grades of index children and VUR grades of siblings when compared as a whole group (p=0.5). However, in siblings under 1 year of age, the Jonckheere-Terpstra test and linear by linear association test showed significant (p=0.04) positive relationship between VUR grades of index children and VUR grades of siblings, implying that index children with higher grade VUR also had siblings with higher grade VUR. We found that where index children had VUR grade 2 or 3, six of eight siblings under 1 year of age, also had VUR grade 2 or 3.

VUR was detected in 47 (45%) of 105 siblings. It was bilateral in 25 and unilateral in 22 of the patients, thus making 72 refluxing units. The grades of VUR were distributed as follows: 42 (58%) were grade 1, 24 (33%) were grade 2, and six (8%) VUR were grade 3. There was no significant difference between groups of siblings without VUR and those with VUR grade 1, 2, or 3 in terms of sex ratio (p=0.7), but a significant difference (p=0.001) was found in terms of age (table). The mean age of the children with VUR grade 2 and 3 was 24 months, compared with the mean age of 49 months in those children with grade 1 VUR, and 39 months in children without VUR. High grade VUR (grade 2 and 3) had an incidence of 50% (7/14) in the first year of age, compared with a 9% (6/67) incidence in siblings older than 2 years. On the other hand, only one of the 27 siblings with VUR grade 1 was younger than 1 year.

In 43 of 47 siblings with proved VUR, \(^{99m}\text{Tc}-\text{DMSA} \) was performed and focal defects suggestive of renal scarring were found in 10 cases, which presents 23% of siblings with VUR who were scanned and 10% of all siblings in the study. However, in all cases unilateral renal function was more than 44% of total glomerular filtration. Comparing siblings with VUR and renal scars and those with VUR without scars, no significant difference between the two groups was found in terms of age (p=0.2) and grade of VUR (p=0.6). Significant difference (p=0.02) was noted in terms of sex ratio. Nine siblings with scars were girls and only one was a boy.

In one 9 month old male sibling, in addition to the right VUR, grade 2, a left side kidney agenesis was also discovered. Raised blood pressure was found in one 32 month old boy with bilateral VUR, grade 2, and scars in the upper left pole.

**Discussion**

The study indicated that the incidence of VUR in general, and of VUR grades 2 and 3 in particular, was much higher in siblings younger than 1 year, than in older siblings, which correlates with the well known fact that VUR tends to disappear with age.

The rationale of detecting VUR in siblings lies in the fact that children with VUR are more prone to pyelonephritis and to develop renal scars than do children without VUR. Besides, it is of considerable interest that most reflux associated renal scars are already present when the patient is first investigated. This suggests that the development of irreversible renal scarring within one week after the introduction of *Escherichia coli* into the bladder of refluxing piglets, as shown by Ransley and Risdon, may also be true in humans. It also indicates the need for more prompt diagnosis and vigorous treatment of the first UTI, as already suggested by many authors. It has been widely accepted that renal scarring tends to develop mainly in infants and young children, and that new scars or progression of previous scars rarely occur after the age of 5 years. Recently there is growing evidence that this may not be so, and that the severity of VUR, the frequency of UTI and abnormal bladder function are the main contributing factors. It might be hoped that
close follow up and/or either surgical or conser-
vative treatment might reduce the risk of renal
scarring in asymptomatic siblings found on the
basis of family history to have VUR as most of
them will not yet have suffered a symptomatic
UTI. However promising, this presumption has
not yet been proved.

DRVC is a highly sensitive method and ex-
poses the patient to much less radiation than the
x-ray voiding cystography. 11 19 We believe that the
benefit of DRVC in detecting VUR in
asymptomatic siblings outweighs the invasive-
ness of the procedure. We also believe that if
screening is to be recommended, DRVC should
be the procedure of the first choice. It is the
VUR we are looking for, and ultrasound, intravenous urography, or DMSA scintigraphy
could only identify children, to whom damage—
least to a certain extent—has already been
done. Ten percent of siblings in this study were
found to have renal scars. They do not seem to
be of any clinical significance yet, except in one
of the 10 children with renal scarring, who has
already been shown to have hypertension.
Before a more conclusive decision is reached
regarding the rationale of screening asympto-
matic siblings of patients with VUR, a long
term follow up should be done to watch the
progress of scars and the development of
hypertension in this group and compare it with
the findings in children found to have VUR
after bacteriologically proved UTI.

It is not clear up to what age the asympto-
matic siblings of index children with VUR
should be investigated. Van den Abbeele et al
recommend 10 years as the limit, beyond which
siblings should be screened with DRVC, while
with older siblings ultrasonography of the
kidneys should be done. 10 Noe and Jenkins
studied 287 siblings of 221 index patients with
VUR and found a 32% incidence of reflux in
siblings. However, siblings younger than 18
months had a much higher incidence of reflux
than did the older siblings. They recommend a
screening voiding cystogram, preferably with
radionuclide, for siblings younger than 5 years of
age. 20 Their data correlate with ours, where
the highest incidence of high grade VUR was
seen in children under 2 years of age. On the
other hand, a certain number of refluxes of
grade 1 (which in our study were discovered
mostly in the older children), would have
probably been of higher grade if the siblings
had been investigated at an earlier age. Aggarwal
and Verrier Jones report 33 asymptomatic
children with a family history of reflux nephro-
pathy or VUR in first degree relatives. 21 Fifteen
(45%) showed some abnormality of the renal
tract on ultrasonography or micturating cysto-
urethrogramraphy, or both, and 12 of them were
under 2 years of age.

Based upon present data we believe that the
age limit of siblings to whom the DRVC should
be done could be lower than 10 years of age as
recommended by Van den Abbeele et al, 10 but
not lower than 2 years. Currently it is our
practice to screen with DRVC all preschool
siblings of the index child, while older siblings
have renal ultrasonography. In addition, parents
of a child with VUR are instructed that a newborn
sibling should be screened as soon as possible.
This procedure is also likely to be
justified for children of parents with reflux
nephropathy. 22

In conclusion, identifying children with VUR
among asymptomatic siblings could possibly
prevent renal damage and its consequences.
The predictive value of positive family history
alone in identifying VUR in our study was 45%,
and 23% of siblings with VUR were found
to have renal scars. This appears high enough to
justify the routine investigation of asymptomatic
siblings of children with VUR, by using DRVC
at an early age.

We wish to thank Janez Stare MSc for help with statistical
analysis and Linda Camperman for assistance in the preparation
of the manuscript. Tone Žakelj and Ignac Zidar provided
technical assistance. The study was financially supported by the
Ministry for Research and Technology (grant: URP: C3-0561-
363).

1 Alon U, Pery M, Davidai G, Benar M. Ultrasonography in
the radiologic evaluation of children with urinary tract
2 Blickman G, Taylor GA, Lebowitz RL. Voiding cysto-
urethrogramraphy: the initial radiologic study in children
3 Kenda R, Kenig T, Szil M, Zupančič Z. Renal ultrasono-
graphy and excretory urography in infants and young children
4 Leonidas JC, McCauley RGK, Klauber GC, Freetzayas AM.
Sonography as a substitute for excretory urography
5 Mason WG. Urinary tract infections in children: renal
6 Burger RH, Smith C. Hereditary and familial vesicoureteral
7 Jerkins GK, Noe HN. Familial vesicoureteral reflux: a
8 Kenda RB, Kenig T, Boudićna N. Detecting vesico-ureteral
reflux in asymptomatic siblings of children with reflux by
direct radionuclide cystography. Eur J Pediatr 1991;150:
715-7.
9 Noe HN. The relationship of sibling reflux to index patient
10 Van den Abbeele AD, Terres ST, Lebowitz RL et al. Vesicoureteral
reflux in asymptomatic siblings of patients with known reflux:
11 Van U, Treves S. Radionuclide voiding cystography. Urol
12 Hodson CJ, Maling TMJ, McMansom JM et al. The
pathogenesis of reflux nephropathy: chronic atrophic
13 Roberts JA, Kaack MB, Mowant AB. Vesicoureteral reflux
in the primates: IV Infection as a cause of prolonged high-
14 Ransley PG, Rudson RA. Reflux nephropathy: effects of
antimicrobial therapy on the evolution of the early pyelo-
15 White RH. Management of urinary tract infection and
16 Winberg J, Bollegren I, Kalenius G, Molby R, Svensson SB.
Clinical pyelonephritis and focal scarring. Pediatr Clin
17 Winter AL, Hardy BE, Alton DJ, Arbus GS, Churchill BM.
18 Shimada K, Marus I, Ogi H, Okama F. New developments
and progress of renal scarring in children with primary
19 Fernbach SR, Conway JJ. The evolving urodigraphic
evaluation of the lower urinary tract in neonates with
20 Glassberg KI. Annual meeting of the section of pediatric
21 Aggarwal VR, Verrier Jones K. Vesicoureteral reflux:
screening of first degree relatives. Arch Dis Child 1989;64:
1538-41.
Vesicoureteric reflux and renal scars in asymptomatic siblings of children with reflux.

R B Kenda and J J Fettich

*Arch Dis Child* 1992 67: 506-508
doi: 10.1136/adc.67.4.506

Updated information and services can be found at:
http://adc.bmj.com/content/67/4/506

**Email alerting service**

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/