ORIGINAL RESEARCH PAPER

Radiodiagnosis

COMPARISON IN DIAGNOSTIC ACCURACY OF DIRECT RADIONUCLIDE CYSTOGRAPHY WITH VOIDING CYSTOURETHROGRAPHY IN DIAGNOSIS OF CASES OF VESICO URETERIC REFLUX DISEASES.

KEY WORDS: Direct Radionuclide Cystography, Voiding Cystourethrography ,Vesicoureteric Reflux

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ABSTRACT

Objectives- To compare the diagnostic accuracy of direct radionuclide cystography as compared to voiding cystourethrography in detection of vesicoureteric reflux diseases.
Material and methods- A prospective, cross-sectional study that enrolled 54 children (108 renal units) was performed. Specific statistical parameters in detecting and grading VUR with a DRCG were calculated.
Results- DRCG detected 22 of the 32 renal units that had VUR on the VCUG. It had a sensitivity of 69 %, specificity of 100 %, positive predictive value of 100% , negative predictive value of 88 %, accuracy 91% and Coefficient of Agreement - Kappa of 0.76 (highly significant) in detecting VUR as compared to VCUG.
Conclusion- DRCG compared modestly with VCUG in detecting VUR. A voiding study is suggested to improve the sensitivity.

Introduction-

The abnormal retrograde flow of urine from the urinary bladder into the ureter across the vesicoureteric junction is known as Vesico ureteric reflux. The valve which is present at Vesico ureteric junctions allows only flow of urine in one direction that is from ureter into the bladder. Sometimes this valve becomes defective leading to backflow of urine from bladder into ureter.

The 2nd most common cause in functional causes of obstruction in urinary tract in childhood and infancy is Vesico ureteric reflux [1] .

The normal growth and development of children is affected because of Vesico ureteric reflux diseases as it also affects the normal growth of kidneys [2]. The vulnerability of kidneys is maximum in 1st three years of life[3].

The incidence of coexistence of urinary tract infections in children with vesico ureteric reflux diseases is very high that is almost 50%[4]. Therefore it is suggested that all children with urinary tract infection should be screened for Vesico ureteric reflux diseases.

The emphasis in vesicoureteric reflux diseases is its early detection and prompts treatment so as to prevent its potentially deleterious effects on the kidney. Therefore considerable emphasis is laid on an early diagnosis of VUR.

Two imaging modalities are used to diagnose vesico ureteric reflux diseases – (Direct and Indirect) Radionuclide cystography and voiding Cystourethrography .

Voiding Cystourethrography is considered the gold standard for diagnosis of Vesicoureteric reflux[5]. Indirect and direct Radionuclide cystography are relatively newer tests which have the advantage of lower radiation exposure but poor anatomic delineation. Progressive renal scarring is associated with higher grades of vesico ureteric reflux which is an important factor in the management of Vesicoureteric reflux[6].

Grading of vesicoureteric reflux on voiding cystourethrography is done on the basis of guidelines laid down by International Reflux Study Committee criteria [7]. DMSA scan is gold standard for detection of renal scarring.

This study hopes to compare diagnostic accuracy of direct radionuclide cystography and voiding cystourethrography in in diagnosis and grading of vesicoureteric reflux diseases.

Aims –

1) To compare the diagnostic accuracy of voiding cystourethrography (VCUG) with direct radionuclide cystography(DRCG).

Material and methods-

Place of study- Department of Radiology in a tertiary care hospital.
Type of study- prospective, cross-sectional study
Approval of institutional ethical review board was taken.
Sample size- 54 children (108 kidneys)

Inclusion Criteria-

1) Age less than 12 years
2) Voiding cystourethrography and Direct radionuclide cystography should be performed on the same day.
3) No urinary tract infection at the time of study

Exclusion Criteria-

1) Children above 12 years of age
2) Children with urinary tract infection.

Voiding cystourethrography-

- It was the 1st test which was performed.
- Antibiotics were given to the child 1 hour before the test prophylactically
- The bladder was catheterized under aseptic conditions with an infant feeding tube.
- The child was made to undergo xray with fluoroscopic facility, the fluoroscopy was started intermittently to avoid excessive radiation exposure.
- Contrast with appropriate dilution was instilled in the bladder through the catheter.
- The bladder was filled till the child voided urine around the catheter.
- Oblique films were taken in males to examine the posterior urethra.

Vesico ureteric reflux if present was graded according to the International Reflux Study Committee (IRSC) classification.

The results of Voiding cystourethrography were withheld from the doctor performing direct radionuclide cystography and vice versa.

Direct Radionuclide Cystography-

- Bladder was allowed to fill naturally and the older children were instructed to indicate when they had an desire to micturate. About 100 – 500 micro Curie of 99mTcDTPA was injected into the bladder by a suprapubic puncture under usg guidance.
- The child was positioned with its back facing the Gamma camera and full bladder images was obtained.
- Continuous voiding images were obtained with a maximum exposure time of 100 seconds. All the images were accessible in real time through for documentation & interpretation .
- In infants and younger children where voiding exposures were not possible, immediate post void images were obtained.

The VUR was graded as per an Institutional Grading (IG) protocol.

Table 1 : Institutional Grading (IG) of VUR on the DRCG.

INSTITUTIONAI GRADE (IG)	CRANIAL DISTRIBUTION OF RADIOACTIVITY AND DELINEATION OF URINARY TRACT ANATOMY
I	Lower ureter
2	Upper ureter
3	Undilated pelvicalyceal system
4	Mild dilatation of the pelvicalyceal system
5	Gross dilatation of the pelvicalyceal system.

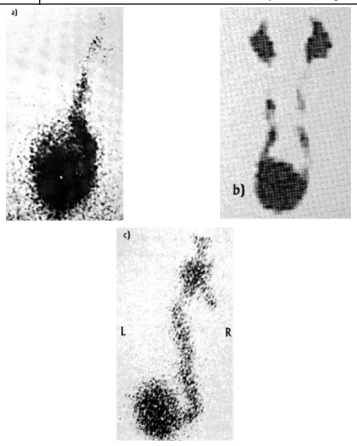


Fig. 1 a) DRCG with right grade 4 VUR , b) DRCG with right grade 3 VUR, c) DRCG with bilateral grade5 reflux according to the IG protocol (Note - the side is as visualizedfrom behind the patient)[8,9]

The data thus obtained were statistically analyzed to yield the following –

- Number of renal units with VUR in each test
- Sensitivity (True positives / True + False positives X 100), and Specificity (True negatives / True + False negatives X 100) of DRCG as compared to VCUG in detecting VUR.
- Positive predictive value formula (True positives / True positives + False negatives X 100) and Negative predictive value formula (True negatives / True negatives + False negatives X 100)should be calculated of DRCG as compared to VCUG in detecting VUR.
- Observed agreement or Accuracy (True positives + True negatives / Total number of units X 100) of DRCG versus VCUG in detecting VUR.
- Coefficient of agreement - Kappa between DRCG and VCUG in detecting VUR
- Distribution and differences in grading of VUR between the tests
- Observed agreement or Accuracy of DRCG versus VCUG in grading VUR
- Coefficient of agreement - Kappa between DRCG and VCUG in grading of VUR

Results-

Table 2. distribution of presenting complaints / provisional diagnosis is tabled below (Table 2)

PRESENTING COMPLAINTS / PROVISIONAL DIAGNOSIS	NO. OF PATIENTS
Symptomatic UTI	25
Antenatally detected hydronephrosis / asymptomatic	15
Secondary VUR eg. Neurogenic bladder	5
Known cases of VUR on follow up	5
Infravesical obstructive uropathy	4

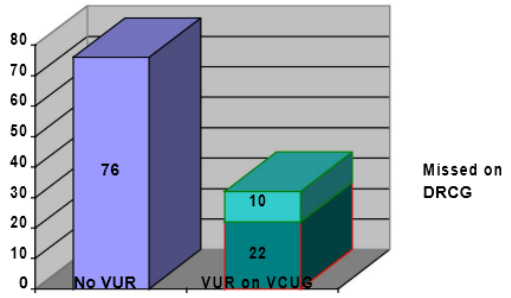
Detection of Vesicoureteric Reflux(VUR) on the Voiding cystourethrography (VCUG)-

Considering VCUG as the Gold Standard, VUR was diagnosed in a total of 32 / 108 kidneys (35%) in 21 patients. Of these 15 were males and 6 females ; the VUR was bilateral in 11(22 kidney units) and unilateral in 10 (10 kidney units) patients . Males predominated in unilateral (7 / 10 patients) and bilateral (8 / 11patients) reflux reflecting the overall sex distribution of cases.

Detection of VUR on the Direct radionuclide Cystography (DRCG)

VUR was detected in a total of 22 /108 kidney units (20.1 %) in15 patients, 10 males and 5 females. Males predominated in unilateral (5 / 8 patients) and bilateral (5 / 7 patients) reflux . Figure 5 illustrates the number of kidney units with and without VUR in both the tests.

Fig.2 : Detection Of Vur In Renal Units.



DRCG was unable to detect VUR in 10 of 32 kidney units that showed VUR on the VCUG. Of these, 3 were of Grade I , 1 of Grade II and 6 of Grade III IRSC grades. There were none of IRSC grade IV / V that were missed by the DRCG.

When DRCG was compared to VCUG in the detection of VUR, the following were the specific statistical correlates which can be calculated from the following Table

Table 3 showing the distribution of kidney units with respect to detection of VUR

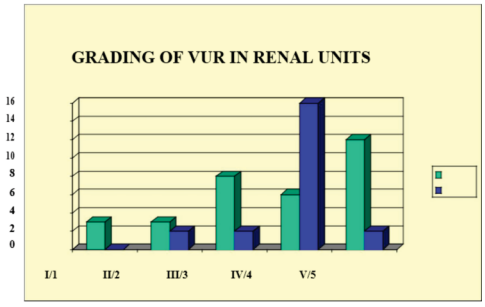
		VCUG +	VCUG –
DRCG	+	TRUE POSITIVES 22	FALSE NEGATIVES 0
	–	FALSE POSITIVES 10	TRUE NEGATIVES 76

Sensitivity(22 / 32 X 100)- 69 %
Specificity(76 / 76 X 100)- 100 %
Positive Predictive Value(22 / 22 X 100)- 100 %
Negative Predictive Value(76 / 86 X 100)- 88 %
Accuracy (96/108 X 100)- 91 %
Coefficient of Agreement (Kappa) - 0.76
(with a one tailed $p < 0.001$, significant)

Grading of VUR on the DRCG

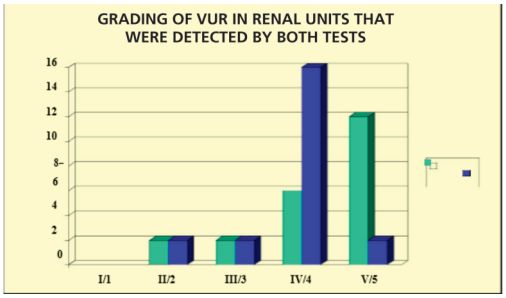
Figure 3 summarizes the distribution of VUR grades on the VCUG (IRSC grade) and the DRCG (Institutional grade) for the renal units detected to have VUR on the respective tests.

Fig.3 shows the distribution of the grades of VUR, in the 32 kidney units, which were detected on VCUG and DRCG.



Green color bar graph- Voiding Cystourethrography (VCUG)
Blue color Bar graph- Direct radionuclide cystography (DRCG)

Fig.4 shows the distribution of the grades of VUR, in the 22 renal units which were detected on both VCUG and DRCG.



Green Bar graph indicates- VCUG
Blue Bar graph- DRCG

Overall, the grading of VUR on the DRCG was comparable to that on the VCUG. If Grade 0 was taken into account then identical grades were seen in 76 out of the 108 kidney units, giving a total of 84 kidney units, which had exact grading in both tests. DRCG failed to detect VUR in 10 out of 32 kidney units that showed VUR in VCUG. Of these 3 were Grade I , 1 of Grade II and 6 of Grade III. Thus the higher grades of VUR (IRSC grades IV and V on VCUG) were always picked up on DRCG while the lower grades (IRSC grades I – III) were occasionally missed.

Of the 22 kidney units that manifest VUR on both tests, identical grades of VUR were reported in 8. It differed in 14 of 22 kidney units , in all the difference was a single grade. The higher grade was usually on the VCUG except for 2 kidney units a higher grade was seen on the DRCG.

Table 4 depicts the distribution of renal units , the presence/absence of VUR ,and the grades assigned to them in the two tests in the form of a grid. The figures in bold across the diagonal are the number of renal units where the test results are in total agreement and the figures farther from this axis reflect increasing degrees of disagreement between the two.

		VCUG					
	VCUG / DRCG	NIL	I	II	III	IV	V
DRCG	NIL	**76**	3	1	6	0	0
	1	0	**0**	0	0	0	0
	2	0	0	**1**	1	0	0
	3	0	0	1	**1**	0	0
	4	0	0	0	0	**5**	11
	5	0	0	0	0	1	**1**

The accuracy of grading on Direct Radionuclide Cystography (DRCG) as compared to (Voiding Cystourethrography)VCUG was **78 %**.

The coefficient of agreement Kappa is **0.48** (with a one tailed p value of 0.00000 , which is highly significant).

Conclusion-
In this study comparing DRCG and VCUG in the detection and grading of VUR conducted on the same day, the following were observed

1. DETECTION OF VUR
DRCG compared modestly with VCUG in the detection of VUR with a sensitivity of 69 % and negative predictive value of 88 %.

The specificity (100 %) , positive predictive value(100%) and accuracy (90.74 %) were excellent while coefficient of agreement with VCUG (Kappa – 0.76) was highly significant.

Low grade VUR(IRSC I-III) was occasionally likely to be missed on DRCG.

2. GRADING OF VUR
Despite minor differences in grading of VUR between the Institutional Grading of DRCG and IRSC grading of VCUG , we note considerable agreement between the two systems (accuracy - 77.78 % , coefficient of agreement with VCUG - Kappa of 0.48 , significant).

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