 

CASE REPORT

# Vesicoureteric reflux: discordant findings on direct and indirect radionuclide cystography

Kottekatu K Balan*[,1], Sonada Lu[1], M Williams[2]

Departments of [1]Nuclear Medicine and [2]Paediatric Urology, Addenbrooke's Hospital, Cambridge, UK

## Abstract

Radionuclide cystography, direct (DRC) and indirect (IRC), has been used to detect vesicoureteric reflux (VUR) for years. DRC is generally performed in female children who do not have bladder control and requires the introduction of a urinary catheter. IRC is more physiological, avoids bladder catheterization and allows estimation of renal function as well as assessment of VUR. The intermittent nature of VUR and absence of a gold standard to confirm it however make comparisons between various diagnostic techniques difficult. Further, negative finding on IRC in children with a dilated renal pelvis does not completely rule out reflux. In this report, the authors have described the detection of VUR on DRC in a 7-year-old girl with a dilated pelvicalyceal system in whom IRC was normal on two previous occasions. The case highlights the need to perform both IRC and DRC or just the latter only in patients with pelvic dilatation and strong clinical suspicion for VUR.

***Key words**: Vesicoureteric reflux, direct radionuclide cystography, indirect radionuclide cystography, micturating cystourethrography*

***Correspondence**

Dr K K Balan
Department of Nuclear Medicine
Addenbrooke's Hospital
Cambridge CB2 0QQ
Email:KK.balan@addenbrookes.nhs.uk

## Introduction

Nuclear medicine techniques are invaluable for assessing children with urinary tract disorders. Direct and indirect radionuclide cystograms are routinely performed to evaluate vesicoureteric / vesicorenal reflux in the appropriate clinical context. Direct cystograms may also be used in patients with a negative indirect micturating cystogram and high clinical suspicion for reflux.

## Case report

A 7-year-old girl with the history of frequent urinary tract infections underwent an IRC after intravenous administration of 40 MBq $^{99m}$Tc-mercaptoacetyltriglycine (MAG3) using a single-headed gamma camera (SMV SophyCamera-DS7) linked to a computer system. The review of cine and static images along with time-activity curves showed significant tracer retention in the dilated pelvicalyceal system bilaterally, but there was no definite evidence of VUR (Figure 1). The study was also negative for VUR when repeated a year later. However, on the basis of the high clinical suspicion and ongoing urinary tract symptoms, a DRC was requested by the clinicians although this was not the standard practice for the age group in our Department. The test was performed after administering 20 MBq of $^{99m}$Tc-pertechnetate via the injection port on the drip line followed by rapid saline infusion to fill the bladder.

 2221-0288(201201/02)1:1<55:VRDFDI>2.0.TX;2-M

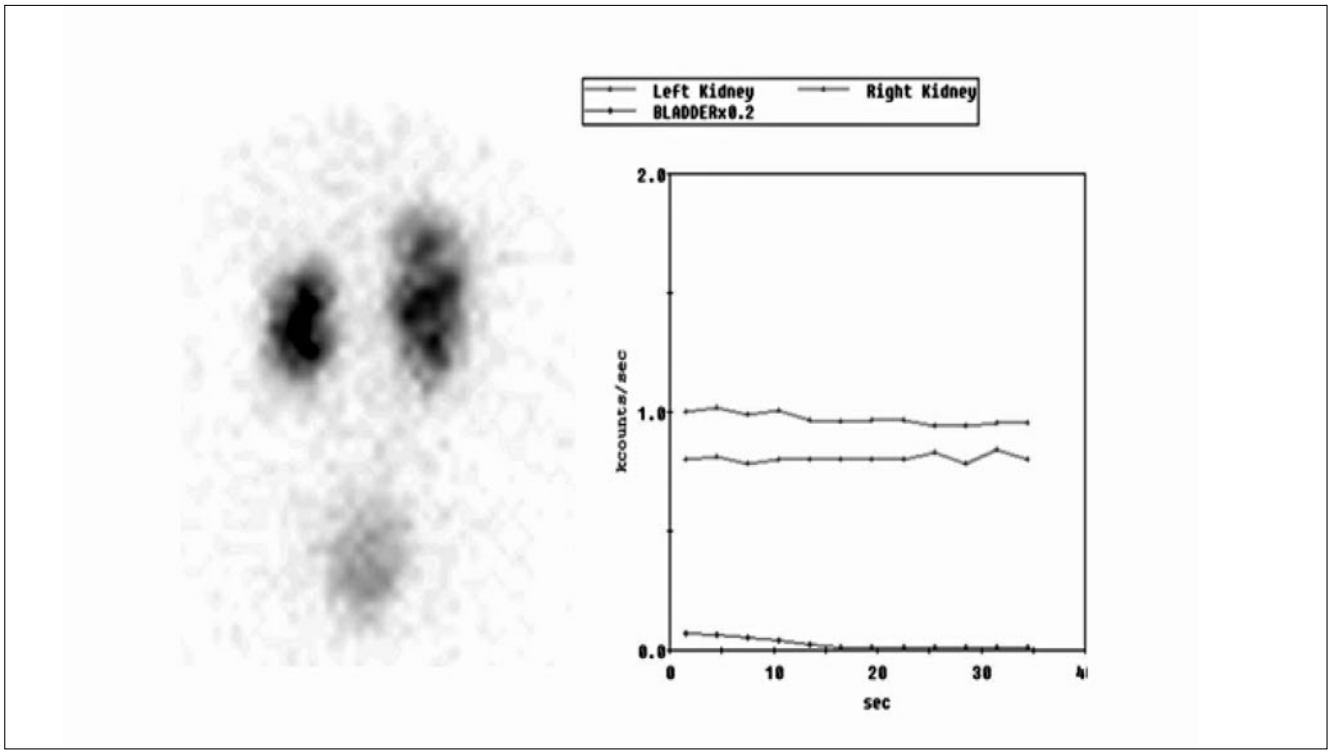


***Figure 1*** *Indirect radionuclide cystography showing significant tracer retention in the renal collectings system bilaterally (more on the left) with the time-activity curves showing no evidence of vesicoureteric reflux on either side*

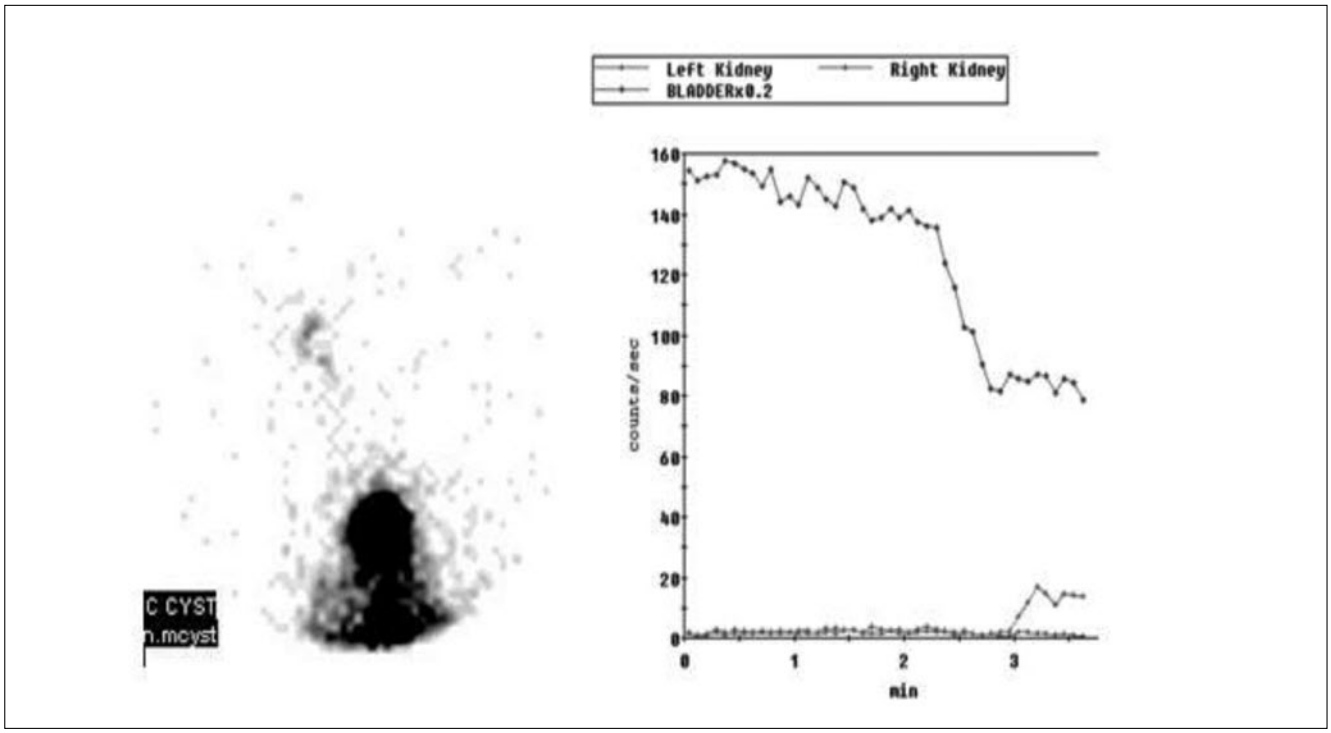


***Figure 2*** *Direct radionuclide cystogram showing vesicoureteric reflux extending into the left kidney as confirmed on the time-activity curves*

Dynamic acquisition of computer data was continued for a few frames after micturition was complete. The results showed prominent VUR on the left side (Figure 2). There was no evidence of VUR on the right side.

## Discussion

VUR in children is associated with urinary tract infection and renal scarring. VUR can be detected by contrast micturating cystourethro graphy (MCU), and radionuclide DRC or IRC.

The advantages of IRC include avoidance of bladder catheterization, low radiation dose, continuous monitoring during procedure and demonstration of reflux under physiological conditions [1-6]. Avoidance of bladder catheterization is unique to IRC and is important because it eliminates the risk of introducing infection during catheterization and makes the procedure less invasive and traumatic. Also unique to IRC is the detection of VUR under physiological conditions. MCU and DRC involve artificial bladder filling, which may exaggerate bladder pressure and produce reflux that may not occur under physiological conditions although this is difficult to determine [6-9]. Other advantages of IRC are shared by DRC including significantly lower radiation dose that makes radionuclide cystography suitable as follow-up studies.

The disadvantages of IRC include poor anatomical information, failure to exclude posterior urethral valve, inability to detect reflux that occurs during bladder filling [10] and the need for patient cooperation. Hence, IRC is not suitable for boys with no prior MCU and children who do not have bladder control. In our center, IRC was the recommended procedure for a 7-year-old girl with suspected VUR.

Studies comparing the indirect with direct techniques like MCU and DRC have produced mixed results with some suggesting IRC has lower sensitivity [4] while others reporting that it is as good or even better [1-3, 5, 7-9]. Investigations using $^{99m}$Tc-MAG3 for IRC showed poorer results [4] compared with those using $^{99m}$Tc- DTPA, raising the possibility of false-positive results associated with $^{99m}$Tc-DTPA in IRC [1-5, 7-9]. Of note is the discordance observed between IRC and the direct techniques whereby some refluxes detected on IRC were not seen on direct techniques and vice versa [1-3, 5, 7-9]. VUR is believed to occur intermittently and different results may be achieved when the same test is performed on the same patient at different times [1-3, 5, 7-9, 11]. The intermittent nature of VUR and the absence of a gold standard method of confirmation make interpreting such comparative studies difficult.

Analyzing time-activity curves in conjunction with careful cine display is important in interpreting the IRC, especially when there is significant tracer retention in the kidneys making it very difficult to appreciate an increase in renal activity during micturition. However, some practitioners do not review the time-activity curve due to its susceptibility to movement artifact [4]. Susceptibility to movement artifact can be minimized by careful plotting of the regions of interest and analyzing the time-activity curves in conjunction with the images. In our case, the time-activity curves helped to confirm the absence of VUR on IRC.

## Conclusion

We have thus highlighted the difficulty of detecting VUR on IRC in children with a dilated renal outflow tract. Our experience suggests, despite practical issues, the need to perform a DRC in addition to IRC in children with prominent pelvicalyceal system, a high clinical suspicion and negative VUR. In such cases, it may sometimes be worthwhile doing DRC in the first instance.

## References


1. Hedman PJ, Kempi V, Voss H. Measurement of vesicoureteric reflux with intravenous 99mTc-DTPA compared to radiolographic cystography. Radiology 1978; 126:205-208.
2. Gordon I, Peters AM, Morony S: Indirect radionuclide cystography: a sensitive technique for the detection of vesico-ureteral reflux. Pediatr Nephrol 1990; 4:604-606.
3. Chapman SJ, Chantler C, Haycock GB, et al: Radionuclide cystography in vesicoureteric reflux. Arch Dis Child 1988; 63:650-651.
4. De Sadeleer C, De Boe V, Keuppens F, et al: how good is technetium-99m mercaptoacetyltriglycine indirect cystography? Eur J Nucl Med 1994; 21:223-227.
5. Carlsen O, Lukman B, Nathan E. Indirect radionuclide renocystography for determination of verisco-ureteral reflux in children. Eur J Nucl Med 1986; 12:205-210.
6. Peters AM, Morony S, Gordon I: Indirect radionuclide cystography demonstrates reflux under physiological conditions. Clin Radiol 1990; 41:44-47.
7. Pollet JE, Belman AB, King LR: Intravenous radionuclide cystography for the detection of vesicorenal reflux. J Urol 1981; 125:75-78.
8. Handmaker H, McRae J, Buck EG: Intravenous radionuclide voiding cystography (IVRC). Radiology 1973; 108:703-705.
9. Merrick MV, Uttley WS, Wild R: A comparison of two techniques of detecting vesico-ureteric reflux. Br J Radiol 1977; 50:792-795.
10. Stabler J, Dossetor J. Detection of vesico-ureteric reflux. Lancet 1989; 2:1521.
11. Dodge EA: Vesicoureteric reflux diagnosis with iodine-131 sodium orthoiodohippurate. Lancet 1963; 1:303-304.


 2221-0288(201201/02)1:1<55:VRDFDI>2.0.TX;2-M