

**EFFECTIVENESS OF DIRECT AND
INDIRECT RADIONUCLIDE CYSTOGRAPHY
IN DETECTING VESICoureTERAL REFLUX**

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A modification of the direct radionuclide cystography technique to include filling, voiding, and postvoiding phases of the examination permitted a simulated comparison between direct and indirect radionuclide cystography. One hundred thirty-seven examples of reflux were documented with this technique. Of these, 96 instances of reflux (70%) were recorded during two or more phases and thus would have been detected by either technique. Twenty-nine examples (21%) were only detected during filling and thus would have been missed by the indirect radionuclide technique and by some roentgenographic techniques. Only 12 examples (9%) were detected during the voiding phase only. The modified direct method of radionuclide cystography, which continuously monitors the urinary tracts during filling, voiding, and postvoiding, is offered as the best current technique for assessing vesicoureteral reflux.

Radionuclide cystography has proven to be an effective and safe technique for the detection of vesicoureteral reflux (1). Direct and indirect techniques are currently available. The direct method requires the instillation of the radionuclide into the bladder through a catheter. Images of the upper urinary tracts are obtained throughout the examination. Radioactivity appearing in the ureter and kidney areas indicates vesicoureteral reflux. The indirect method depends on the rapid complete renal clearance of the radionuclide from the blood after intravenous injection. The upper urinary tract areas are imaged during and after voiding. A significant increase in radioactivity at these times indicates reflux. The original techniques for both methods (2,3) bear little resemblance to present techniques, which utilize the scintillation camera and more suitable radiopharmaceuticals such as ^{99m}Tc -pertechnetate, ^{99m}Tc -sulfur

colloid, or $^{99m}\text{Tc}(\text{Sn})\text{-DTPA}$ (diethylenetriamine-pentaacetic acid). The documentation of vesicoureteral reflux is now based on the visual illustration of the refluxed radioactivity as opposed to a graphic record of radioactivity detected from the renal areas.

An earlier direct technique had imaged the urinary tracts only during filling and after voiding (4). The indirect technique, described by Handmaker (5), detects reflux only during the voiding and postvoiding phases of the examination. Therefore, a modification of the earlier direct technique to include voiding images not only fulfills the requirements for direct cystography, but also simulates the ideal for the indirect method—a situation where the radionuclide has been completely cleared from the blood stream. This simple modification allows a comparative study to be performed with no additional hazard to the patient; this is important since comparative research studies with radionuclides are ethically difficult to defend in children. This report documents a prospective study on the differences in the ability of current radionuclide techniques to detect vesicoureteral reflux.

MATERIALS AND METHODS

Vesicoureteral reflux was detected by instilling 1 mCi of ^{99m}Tc -pertechnetate into the bladder through a catheter and then filling the bladder with normal saline. The urinary tract is continuously monitored on a persistence-scope attachment to the scintillation camera, and images are recorded on Polaroid film. The 300,000-count pictures require approximately 5 min for each image. Supine posterior and both posterior oblique projections are initially recorded with

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TABLE 1. DIRECT RADIONUCLIDE CYSTOGRAPHY

Reflux shown at:	Number of patients	Percent
Filling	29	21%
Voiding	12	9%
Filling, voiding, postvoid	96	70%
Total	137	

a high-intensity setting on the scintillation camera in order to visualize small amounts of reflux into the upper urinary tracts. Low-intensity filling and postvoiding images which include the bladder are also obtained in order to monitor the bladder more adequately and to quantitate total abdominal radioactivity for the subsequent calculation of various functional parameters. During voiding an image is derived which represents the modification of the original technique. A final high-intensity postvoiding posterior image of the urinary tracts completes the study. The filling technique and calculations of various functional parameters from the recorded data have been described previously in greater detail (6).

RESULTS

One hundred thirty-seven examples of vesicoureteral reflux were divided into three types based upon the phase of the examination at which radioactivity was recorded in the upper urinary tracts (Table 1). The three types are defined as (A) during voiding only, (B) during filling only, and (C) during any combination of two or more phases in-

cluding filling, voiding, and postvoiding. This last category contains those examples of reflux that would be picked up by either of the described radionuclide methods.

The majority of instances of reflux (96 cases or 70%) were included in the last category. Of more importance, 29 cases (21%) showed vesicoureteral reflux in the filling phase only (Fig. 1). These examples of reflux would have been completely missed by the indirect technique. Finally, 12 examples of reflux (9%) were only visualized during the voiding phase (Fig. 2).

DISCUSSION

These data emphasize the importance of continuous monitoring of the urinary tracts during any examination attempting to detect vesicoureteral reflux. No consistent correlation was obtained between reflux and the degree of bladder distention in those instances when reflux occurred only during the filling phase. This contradicts the expectation that reflux is related to bladder volume and, in particular, to full distention of the bladder. Bladder pressures were not monitored during this study. However, the filling pressure at small bladder volumes is not likely to be greater than when the bladder is distended or during voiding. In certain instances, then, reflux is probably not related to bladder pressure. The dynamism of vesicoureteral reflux becomes most evident when visualized on the persistence-scope attachment to the scintillation camera. If one wishes to examine the urinary tracts for vesicoureteral reflux, those techniques that only record during certain phases of the examination are at a considerable dis-

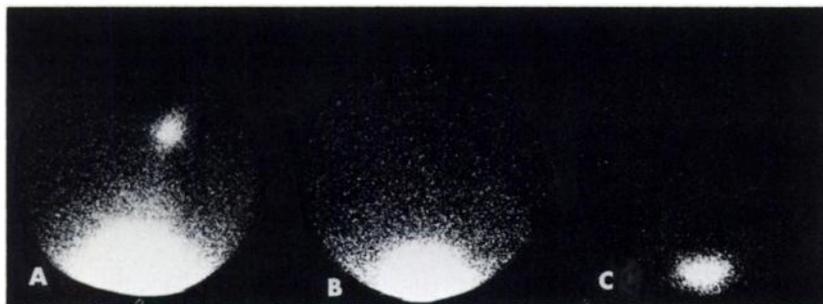


FIG. 1. One of 29 examples (21%) where vesicoureteral reflux was only visualized during filling phase of examination. Such reflux would be missed by indirect radionuclide cystography, emphasizing need for continuous urinary tract monitoring. (A) Filling; (B) voiding; (C) postvoiding phase.

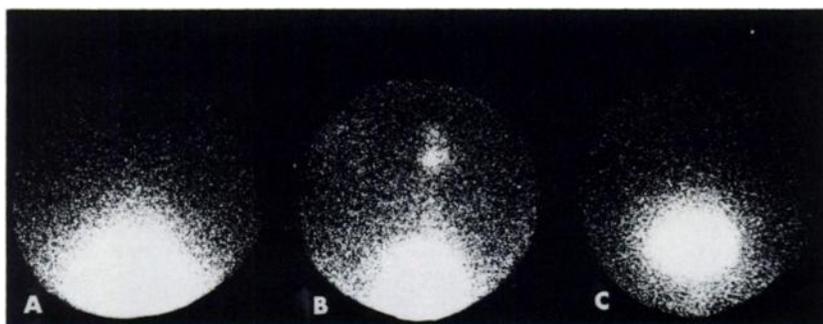


FIG. 2. One of 12 examples (9%) where reflux was only detected during voiding. (A) Filling; (B) voiding; (C) postvoiding phase.

advantage. Continuous monitoring with roentgenographic techniques can only be accomplished at an unacceptable radiation burden to the patient.

In spite of the necessity for catheterization, the direct method of radionuclide cystography, which visualizes the urinary tracts during all three phases (filling, voiding, and postvoiding), is unquestionably superior to the indirect method of radionuclide cystography for showing vesicoureteral reflux.

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Regular exhibits may be large or small, free standing or illuminated by viewbox, and offer a means whereby attendees can take their time to view the material, assimilating and digesting the information at their own pace. The special residents and fellows category is designed to encourage physicians who are training in the field of nuclear medicine to participate in the national meeting. The jiffy exhibits, whose introduction last year was so successful, offer an opportunity for those presenting scientific papers to present the salient features of their paper in exhibit format so that participants in the meeting can review the data at their leisure.

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