PAUSE AND PULSE: Voiding Cystourethrography (VCUG) in children – Tips for Dose Optimization

**Scope of VCUG use in pediatrics**

- Number of examinations: In a busy urban, academic children’s hospital, 1,752 VCUGs were performed in 2007 (personal communication November 2008). This number does not account for other pediatric uroradiology examinations that utilize fluoroscopic imaging, such as genitograms and nephrostograms. However, the 1,752 VCUGs performed are illustrative of the frequency of this examination in pediatric imaging.
- Clinical importance of the VCUG: The diagnosis of vesicoureteral reflux can only be made by VCUG or Radionuclide Cystogram (RNC). VCUG utilizes ionizing radiation and provides anatomical detail that is of the utmost clinical and surgical importance to the pediatrician and pediatric urologist. RNC can also be performed to diagnose reflux, but RNC images lack the anatomic detail of VCUG images.

**PAUSE and Prepare For the Examination**

**Prior to examination**

- Clinical indication: Prior to VCUG, obtain a thorough clinical history from the child’s parents/guardians and referring pediatrician or pediatric urologist to confirm that the child actually needs an imaging examination that utilizes ionizing radiation.
- The most common and appropriate indications for the performance of VCUG in children are febrile urinary tract infection or prenatal hydronephrosis. VCUG is used to diagnose and characterize vesicoureteral reflux, and also to evaluate lower urinary tract anatomy: urethra, bladder, and ureters if reflux is present.
- Alternative imaging: Choose the correct examination for detecting and characterizing vesicoureteral reflux.
  - Fluoroscopic VCUG vs. radionuclide VCUG (RNC) - In certain clinical instances, the diagnosis of vesicoureteral reflux can be made with RNC, which can be performed at even lower radiation doses than VCUG. However, RNC is limited by its lower anatomic detail and inability to evaluate bladder or urethra. Therefore RNC indications are limited to:
    - follow-up of known vesicoureteral reflux,
    - follow-up of ureteral reimplantation surgery
    - evaluation of asymptomatic sibling reflux (i.e. family screening).

**Patient preparation**

- Explain procedure, risks and required immobilization to patient &/or parents,
  - a cooperative and helpful patient &/or parent can greatly shorten study and exposure.
Overhead exposure scout views may not be necessary in all cases. Pause and think of indications before obtaining such an additional view, and collimate off the body parts that do not need to be included.

Procedure

**PAUSE and PULSE During The Examination**

- **PAUSE** to choose the appropriate clinical indication for performing VCUG
  - to think whether a scout view is needed; if needed, can it be done with fluoro-grab rather than full exposure?
- **PULSE** Use pulsed fluoroscopy to perform VCUG rather than continuous fluoroscopy. Pulse at lowest possible rate
- Minimize the number of actual recorded images that you obtain
- Use last image hold to review anatomy, rather than additional fluoroscopy
- Use fluoro-grab rather than exposed images when possible
- Collimate the fluoroscopy field-of-view to the anatomy of interest, such as the UVJ or urethra.
- Use your eyes, rather than fluoroscopy, to detect initiation of micturition
- Practical considerations about effective radiation doses from VCUG versus RNC: A recent publication [1] reviewing VCUG examinations performed in children of varying ages and sizes provides some practical comparisons of the effective radiation doses delivered with grid-controlled, variable rate pulsed fluoroscopy (GCPFL) versus continuous fluoroscopy (CFL) versus radionuclide cystography (RNC). It is helpful to think about the effective radiation dose in terms of the number of days of annual background radiation. Our study results showed that the:
  - Effective dose to a newborn from VCUG performed with a GCPFL unit corresponds to 9 days of annual background radiation (at sea level in the USA);
  - Effective dose to a newborn from VCUG performed with a CFL unit corresponds to 10 weeks of background radiation; and
  - RNC corresponds to 1 day of background radiation.

As is always the case, the potential risk of the effective radiation dose associated with VCUG has to be balanced with its diagnostic benefit and the clinical need for the information.

**SUMMARY:**

- **PAUSE** to properly plan and prepare for study
- Activate dose saving features of equipment
- No exposures unless necessary
- Depress last image hold and last image grab instead
- **PULSE** at lowest possible rate

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References

