KEY

Studies Relating to Side Effects & Potential Complications of VCUGs

Studies Relating to VCUG Trauma & Related Psychological Problems (includes all studies where VCUG survivors are used in place of CSA victims)

Studies Comparing the Efficacy of VCUG Against Other Alternatives

Studies Relating to Reliability of VCUGs OR Lack of Standardization of VCUG Protocol

Studies Relating to Genetics of VCUGs

Studies Relating to VUR/UTIs

Full In-Depth Timeline of All Research Surrounding VCUG Trauma

1989

***Reliability of Voiding Cystourethrography to detect reflux* (Quebec, CA)**

- "Retrograde voiding cystourethrography (VCUG) with contrast medium came into widespread use around 1958, when fluoroscopes with image intensification and cine recording became generally available"
- "Purpose of this study was to establish the reliability of VCUG by repeating the VCUG and comparing the results of a consecutive second and/or third cyclic filling and voiding to the first study"
- 22 out of 177 patients had a discrepancy in the results between two cycles
- "**By no means do we advocate multiple fillings in all children**."
- "To select patients who might benefit from cyclic voidings, we suggest that in children with urinary tract infection a sonogram be obtained BEFORE VCUG"

1990

***The Goodman Study* (United States)**

1994

***Children's memory for a salient medical procedure: implications for testimony* (United States)**

- **"Children's memory for features of a VCUG experience were examined because this invasive procedure is similar in many respects to incidents of sexual abuse."**

- "The children remembered 88% of the component features of the VCUG experience at the initial assessment and 83% after 6 weeks. Behavioral and salivary cortisol measures indicated that the children were distressed during the procedure. "

- "Although the VCUG shares many features with instances of sexual abuse, there are differences that may affect generalization and interpretation. Unlike many cases of sexual abuse, for this sample the VCUG did not occur repeatedly overtime. Although this ensures that previous knowledge is unlikely to inflate recall performance, it also prevents the applicability of the present findings to events that occur repeatedly over long periods of time. Additionally, the assessment of recall occurs immediately after the procedure, before time has elapsed during which, forgetting, and or suggestion may occur. To address these differences, children are now being recruited who had multiple experiences with the VCUG."

1997

Remembering early experiences during childhood (United States)

- Once again, VCUGs are used to test the recall of traumatic memories in children

- "Several recent studies have explored **children's memories of painful and even distressing medical procedures, such as... the fluoroscopic VCUG**. These procedures, although by no means perfect analogues for the kinds of events of interest in the debate concerning memory for traumatic events, include a number of important features that may enhance their ecological validity. **A number of aspects of the VCUG procedure, in particular, make it a potentially useful analogue event**"

- "There is evidence that children remember the VCUG better than a more routine physical examination"

The medical management of intersexed children: an analogue for childhood sexual abuse (United States)

- "Medical procedures have often been used as analogues for childhood sexual abuse (CSA) and have been seen as opportunities to observe children's memories of these experiences in a naturalistic context. **Medical traumas share many of the critical elements of childhood abuse, such as fear, pain, punishment, and loss of control, and often result in similar psychological sequelae**"

- "**The study which has come closest to identifying the factors likely to be involved in children's recall of CSA is a study by Goodman (1990) involving children who experienced a VCUG test to identify bladder dysfunction. Goodman's study was unique in its inclusion of direct, painful, and embarrassing genital contact, involving the child's being genitally penetrated and voiding in the presence of the medical staff**. Goodman found that several factors led to greater forgetting of the event: embarrassment, lack of discussion of the procedure with parents, and PTSD symptoms. These are precisely the dynamics likely to operate in a familial abuse situation."

- "Children who had experienced more than one VCUG were more likely to have expressed fear and embarrassment about the most recent test and to have cried about it since it occurred. **A few even denied that they had had the VCUG**."

Follow-up study of urinary tract infection associated with vesicoureteral reflux (South Korea, translated from Korean)

- "**Rates of disappearance of VUR in medical and surgical management were 66% and 97%, respectively**. The spontaneous cure rate of VUR seemed to be higher in the cases with a milder grade of reflux and before 5 years of age."

Management of anxious and painful manifestations in pediatric uroradiology

- "Pediatric radiologists should evaluate pain and stress in their patients as they can be **easily and safely limited**."

1998

Test or trauma? The voiding cystourethrogram experience of young children (United States)

- "**Healthcare professionals often perceive invasive procedures such as surgery and needle biopsies as more painful and threatening to the child than "test" such as VCUGs. However, clinical experience indicates that the VCUG is often perceived by children as more highly distressing than other procedures.**"

1999

Emotion and memory: children's long-term remembering, forgetting, and suggestibility (United States)

- "We examined children's long-term memory for a **documented medical procedure, VCUG, that involves painful and stressful genital contact.** "
- "In the present study, we examined children's long-term memory for **VCUG, a test that many children find frightening, distressing, and also embarrassing.**"

Children's recall of medical experiences: the impact of stress (New Zealand)

- "**Ratings of stress were significantly higher for children who underwent the VCUG than those who underwent the pediatric assessment.** "
- "Several recent studies have investigated children's memory for VCUG which involves an x-ray of the child's kidneys. **This procedure has some of the features of an abusive experience in that it is likely to involve discomfort and, in many cases, stress for the child, and also involves genital touch**."

2001

Perception of fear, distress, and pain by parents of children undergoing a micturating cystourethrogram (aka a VCUG) (Australia)

- "There were significant differences between anticipated and experienced parental anxiety. Parents' reporting of fear, distress, and pain in their child during the MCU and after the procedure was lower than they had anticipated."

A family screening of patients with vesicoureteral reflux (South Korea, translated from Korean)

- "Vesicoureteral reflux is the most commonly inherited disease detected in children with urinary tract infection. The incidence of vesicoureteral reflux among siblings of children with known VUR is 8% to 45% according to different authors."
- Study consists of 27 families of patients with VUR, scans (BUN, Cr, urine analysis, VCUG, and DMSA) were performed on siblings and parents (minus the VCUG).
- "The abnormality was detected in 7 of 27 families (25.9%). VUR was detected in 5 of 20 siblings and renal scar was detected in 3 of 32 parents. In children with VUR, renal scar was detected in 24 of 32 children."

Evaluation of timing of voiding cystourethrogram after urinary tract infection (South Korea, translated from Korean)

- "We analyzed patients' records to evaluate whether the timing of VCUG after UTI influenced the prevalence or severity of VUR."
- Reviewed 213 children diagnosed with UTI from March 1997 - December 2000. The children were divided into two groups, scheduled VCUG within 1 week of UTI and after 1 week of UTI.
- "Reflux was present in 19% of patients studied within 1 week after UTI and 18% of those studied after 1 week. The difference was not statistically significant. Whereas

100% of the scheduled VCUGs in the Group A (within 1 week) were performed, only 48% of those scheduled in Group B (after 1 week) were performed."

Reduction in voiding cystourethrographies after the introduction of contrast enhanced sonographic reflux diagnosis (Germany)

- "**Voiding urosonography** (VUS) using the intravesical application of an US contrast medium (Levovist) has been **shown to have very high sensitivity and specificity in the diagnosis of vesicoureteral reflux (VUR) compared to voiding cystourethrography** (VCUG)."

- "The **number of VCUGs was significantly reduced as a result of the implementation of VUS** as part of the routine diagnostic imaging modality for VUR. Consequently, the **number of children that would have been exposed to ionizing radiation was reduced by over half.**"

2002

Predicting children's response to an invasive medical investigation: the influence of effortful control and parent behavior

- "Children manifested relatively high rates of distress and low rates of coping. Their coping attempts were not associated with reduced rates of distress."

2004

Detecting deception in children: event familiarity affects criterion-based content analysis ratings (United States)

- "**The VCUG procedure was used as the target event in this study because it is similar in many ways to child sexual abuse**, the real world behavior that we hope to generalize these results to. However, whereas we knew exactly what had occurred in the medical procedure that each child in this study participated in (the procedures

were videotaped), practitioners rarely know what transpired in alleged incidents of sex abuse."

2005

Hypnosis reduces distress and duration of an invasive medical procedure for children (United States)

- "**VCUG is a commonly performed radiologic procedure in children that can be both painful and frightening**. Given the distress that some children experience during the VCUG and the need for children to be alert and cooperative during the procedure, finding a psychological intervention that helps children to manage anxiety, distress, and pain is clearly desirable"

- 44 children about to undergo a VCUG, 21 received hypnosis. 29 girls and 15 boys, with 72% white, 18% asian, 4.5% latino, 2.3% black, and 2.3% filipino. The mean number of previous VCUGs was 2.95.

- "To be eligible for the study, the child must have undergone at least 1 previous VCUG, been at least 4 years of age at that time, and experienced distress during that procedure."

- "Results indicate significant benefits for the hypnosis group compared with the routine care group in the following four areas: (1) parents of children in the hypnosis group compared with those in the routine care group reported that the procedure was significantly less traumatic for their children compared with their previous VCUG procedure, (2) observational ratings of typical distress levels during the procedure were significantly lower for children in the hypnosis condition compared with those in the routine care condition, (3) medical staff reported a significant difference between groups in the overall difficulty of conducting the procedure, with less difficulty reported for the hypnosis group, and (4) total procedural time was significantly shorter by almost 14 minutes for the hypnosis group."

Systematic review of age-related errors in children's memories for Voiding Cystourethrogram (VCUG) (Europe)

- **PDF Attached Here**

2006

Slides presented at the 2006 AUA meeting

- **VCUGS are "traumatic, distressful, dehumanizing, like sexual abuse"**

Link to Panel Discussion

- "Once reflux is diagnosed, it has been the tradition that most pediatric urologists reassess patients annually. This practice is for a variety of reasons.... **The issues involved with regard to follow up of the study of reflux are radiation exposure, repeated instrumentation of the child, which is a major issue for many families, antibiotic exposure, and finally cost**."

- "Q: We as physicians interested in the urinary tract are severely criticized by many people for saying that we have really not asked the right questions. It has been pointed out in the literature, I believe your literature, how much it costs to avoid end-stage renal disease in one child with a urinary tract infection; the numbers approach 5–15 million dollars in the literature. So I do not really care too much about scars necessarily; I want to know the outcome. **I think we do too many cystograms** and I want to know how the outcome of what you described versus not doing the cystogram because **I think the real issue is that within 5 years, we will not be doing cystograms nor even ultrasonic cystograms because I think catheterizing is invasive** unless there is a real reason to do it. What is your feeling about this?

  A: (Dr. Diamond) This is an opinion that has been in the literature. There was a study from Australia not long ago that voiced this similar opinion. The sense that I have and I think that some of my colleagues have, as well, is that **it is exceedingly uncommon**

for us nowadays to see a patient present in renal failure due to vesicoureteral reflux. My belief is that this is because we are probably doing something right."

- "(Dr. Boyle)… We have done a tremendous job of educating **pediatricians and family practitioners** about this disorder."

- "Q: In ordering a procedure, do you feel that it is your obligation to discuss with the parents what the procedure involves in terms of catheterization, potential pain, radiation exposure, etc., or do you then relegate that responsibility to the radiology personnel? Oftentimes, parents arrive and say, "what, a catheter?!" or "what radiation?!" and there has been absolutely no preparation for these families. What do you think should be the clinician's responsibility for preparing the family for both procedures that can involve pain?

  A: (Dr. Diamond) I have never as a routine gone into the radiologic details because there are limited times in the day for me to see the patients that I need to see. Given the number of studies that we order throughout the day, there is not time to go over real issues with the parents. I think it is proper that someone do it but it is not workable for us to do it.

  A: (Dr. Boyle) our nurses do tell the parents that their child may be restrained"

Fluoroscopy-controlled voiding cystourethrography in infants and children: are the radiation risks trivial?

- "Mean radiation risks for genetic anomalies and carcinogenesis following VCUG during childhood were estimated to be up to 15 per million and 125 per million, respectively."

- "**Radiation risks associated with pediatric patients undergoing VCUG should not be disregarded if such a procedure is to be justified adequately**."

Brief report: optimizing children's memory and management of an invasive medical procedure: the influence of procedural narration and distraction

- "Relative to the PI condition [limited procedural information], children in the CI + D condition [complete procedural information] recalled more information, appraised the VCUG as less painful, and were less distressed."

- "An inexpensive, theoretically driven intervention can enhance children's memory and reduce distress during an invasive procedure."

2007

Study of post procedural complications associated with voiding cystourethrography (Korea, translated from Korean)

- "The **procedure is relatively simple but it involves discomfort and some complications**. We studied post procedural symptoms and complications in children who underwent VCUG."

- 269 patients who underwent VCUGs between October 2005 and September 2006 were analyzed. Chart review and telephone interview with parents was completed.

- "Our study demonstrated that **32.7% of patients showed complications** including bladder rupture and urinary tract infection after VCUG. We also found that prophylactic antibiotic use did not prevent urinary tract infection nor decrease the rate of complications associated with VCUG."

Infantile bladder rupture during voiding cystourethrography (Brazil)

- "We report two cases of infantile bladder rupture during voiding cystourethrography (VCUG). This report reinforces the criteria for proper VCUG imaging procedure."

Voiding urosonography as first step in the diagnosis of vesicoureteral reflux in children: a clinical experience

- "Our experience suggests that **we can use VUS [contrast-enhanced voiding urosonography] as the first step in the diagnosis of VUR in children**, boys and girls, with a **significant reduction in radiation exposure**."

2008

Comparing stress levels in children aged 2-8 years and in their accompanying parents during first-time versus repeated voiding cystourethrograms (Austria, translated from German)

- "**Invasive procedures such as voiding cystourethrograms (VCUGs) cause distress in both children and their accompanying parents**"
- Study included 31 children (2-8 yo) undergoing a repeated VCUG and 31 children (2-8 yo) undergoing their first VCUG. Child and parental behavior during the VCUG was coded by three independent observers using a standardized rating scale (Children reported on stress levels using a faces scale, parents and radiologists rated the child's distress on a visual analog scale)
- "The stress levels of children undergoing a repeated VCUG do not differ from those of children undergoing a VCUG for the first time, but parental stress levels were significantly lower during repeated VCUGs"
- "Parental stress levels and parental distress promoting behavior correlated positively only for repeated VCUGs"
- "CONCLUSION: **Repeated VCUGs and first-time VCUGs are both highly distressing procedures for children**. Even though parental stress levels are lower during repeated VCUGs, spontaneous parental behavior proves to be ineffective or even counterproductive in reducing the child's distress"

Should voiding cystourethrography be performed for infants with urinary tract infection? (South Korea, translated from Korean)

- Reviewed 117 infants hospitalized for UTI between February 2002 and July 2007.
- "28 patients (23.9%) had VUR."
- "Although the negative predictive value of both normal renal sonography and normal DMSA renal scan for VUR was 88.1%, 7 patients had VUR and two of them had high grade reflux (grade IV)."

Urinary tract infection following voiding cystourethrography (South Korea, translated from Korean)

- **"It is well known that VCUG can cause UTI (post-VCUG UTI)."**
- Medical records of 284 patients who underwent VCUGs in 2007 were reviewed.
- "**Seven of 284 children (2.5%) developed UTI after they underwent VCUG**. High grade VUR was the only statistically significant risk factor for post-VCUG UTI, while sex, age, and other anomalies of the urinary system were not significant."
- "Antibiotic use did not prevent post-VCUG UTI in this study"

Chronological age for the spontaneous resolution of vesicoureteral reflux

- "We analyze the chronological age of the patient at which VUR resolves spontaneously, so that we know when we should have a more precise control with VCUG, avoiding a traumatic test and irradiation, but also avoiding to give prophylactic antibiotics without real need."

2009

Effective dose estimation for pediatric voiding cystourethrography using an anthropomorphic phantom set and metal oxide semiconductor field-effect transistor (MOSFET) technology

- "The **risks associated with radiation exposure are higher in children than in adults**."

- "**Effective doses** ranged from 0.10 to 0.55 mSv, **increased with age, and were higher in girls**."

- "**Effective doses for VCUG examinations performed in children <or= 10 years of age are low but not negligible.**"

2010

Development of a patient educational intervention to improve satisfaction of parents whose children are having a VCUG (United States)

- "**The conditions under which the procedure is performed may be frighteningly foreign and threatening to a child's and his or her parents' integrity. Catheter insertion causes mechanical discomfort along with sensations of a full bladder. Emotional distress can occur when a child's private areas are uncovered, prepped, and the catheter is inserted. In summary, a pediatric voiding cystourethrogram procedure can and does cause physical and emotional distress to children and their families.**"

Assessment of parental satisfaction in children undergoing VCUG without sedation (United States)

- "More than half of parents classified the experience of VCUG as equivalent to or better than a physical examination, immunization, ultrasound, and prior catheterization. Most parents were satisfied with the ability of the child to tolerate the procedure and considered the experience better than expected. Children in the process of toilet training had the most difficulty with the procedure, correlating with lower levels of parental satisfaction."

- "More than 750 VCUGs were performed in the authors' diagnostic radiology unit annually, and this number was projected to continue increasing (Tacoma general hospital, 2008)."

- "Because patients came from more than 300 referral sources, education was inconsistent and sometimes nonexistent."

- "The educational DVD produced by the project improved the satisfaction and confidence of a parent whose child was scheduled for a VCUG.... The results showed an increase in parent satisfaction and children's ability to cope with the procedure because of the educational information plus the increase in confidence of their ability to care for their child."

Summary of the AUA Guideline on Management of Primary Vesicoureteral Reflux in Children

- These are the official guidelines specified by the American Urology Association for treating VUR, which all urologists **should** be following.

- "Recommendation: Because VUR and UTI may affect renal structure and function, performing **renal ultrasound** to assess the upper urinary tract is recommended. Option: **DMSA renal imaging** can be obtained to assess the status of the kidneys for scarring and function."

    - Nowhere in the guidelines does it say that children should receive a VCUG upon initial presentation

- "Involvement of the family in clinical decision making related to VUR is critical, and must include balanced and objective education to permit informed decisions regarding imaging and therapy, particularly when one approach may have no demonstrable benefit or advantage over another."

- "Recommendation: If **clinical evidence of BBD** [bladder and bowel dysfunction] is present, **treatment of BBD is indicated**, preferably before any surgical intervention for VUR is undertaken."
    - Once again, no mention of VCUG; although a VCUG **could** be clinical evidence of BBD, renal ultrasounds and urinalysis (which are both previously discussed in the guidelines) are also examples of clinical evidence which can very effectively indicate BBD
- "For high grade VUR, followup as soon as 12 months may be too early, but for low grade it may be appropriate. **Compliance with followup** as well as **parental anxiety** are factors in this determination. There is **little rationale for repeating a VCUG within 12 months of the previous study**, and an outer limit of 24 months appears to be a reasonable time frame to avoid loss of followup or prolonged use of unnecessary CAP if the VUR has resolved."
    - It is mentioned that compliance with followup and parental anxiety can be issues but they don't explain why
- "Voiding cystography (radionuclide cystogram or low-dose fluoroscopy, when available) is recommended every 12 to 24 months with longer intervals between follow-up studies in patients in whom evidence supports lower rates of spontaneous resolution (i.e. those with higher grades of VUR [grades III–V], BBD and older age). This is to limit the overall number of imaging studies performed."
- "For children with grade I–II VUR and more likely spontaneous resolution, followup imaging to identify VUR is considered an option. While followup VCUG is appropriate, **there are no data to support its necessity.** This is particularly true if CAP is not being used, as **the VCUG findings are not likely to alter management**."
    - If there are no data to support the necessity of VCUG in followup, why do many physicians push parents so hard to let them do followup VCUGs? It

wouldn't be an outlandish claim to say that this happens so that urologists can confirm the resolution of VUR and thus boast higher success rates

Parents compliance to perform the voiding cystourethrogram test after urinary tract infection (Israel, translated from Hebrew)

- "AIM: to examine parents' compliance to perform VCUG test after hospitalization due to UTI and factors affecting their decision"
- Data collected between 2004 - 2005, telephone interview with 179 parents (227 children)
- "Overall, **52% of the children didn't perform the VCUG because of concern about exposure to radiation (55%), fear and distress from pain during the test (43%), fear of irreversible damage to the urinary tract (40%), lack of relevant information (35%), and the primary pediatrician's recommendation to postpone the test**. The remaining 48% conducted the test because of the hospital doctor's recommendation (94%), primary pediatrician recommendation (94%), and because of the desire to terminate prophylactic treatment (64%)."
- "There is a significant correlation between the doctors' recommendation and the extent and clarity of their explanation to the parents' understanding of the importance of the test, to the parents' satisfaction from the explanation and to the compliance to perform the test"
- "CONCLUSION: **There is a need to improve the doctors' explanation regarding the performance of VCUG test post UTI.** This will improve the patients' compliance to perform their post discharge recommendation."

Difference of anxiety of parents: before & after the VCUG (South Korea, translated from Korean)

- "As it is a **potentially distressing and invasive test**, most of the parents are so concerned about the child's stress."

- 68 parents whose children underwent VCUG were put into 2 groups, group 1 received a detailed explanation using pictures and group 2 only received an oral explanation.

- "CONCLUSION: **It showed that a doctor's explanation on the procedure in advance may raise the perception of pain and the possibility of refusal by parents**. Anxiety after VCUG were significantly decreased in group 1, while the **confusion and pain were increased in group 2**. Therefore **we suggest that prior and sufficient explanation about invasive procedures like VCUG can be helpful in ameliorating the anxiety of the parents**."

2011

Is parental anxiety and coping associated with girls' distress during a VCUG? Preliminary findings (United States)

Purpose: *"We investigated the relationship between parental anxiety/coping strategies and girls' distress during VCUGs."*

- "Trends indicated that parents who reported increased anxiety rated their children as experiencing increased distress."
- "Contrary to expectations, parent anxiety scores on the STAI completed prior to the VCUG were not significantly related to parent self-rated or staff-rated parent anxiety recorded after the VCUG (r Z 0.09 and 0.02), or to ratings of children's procedural distress (r Z 0.11, 0.01 and 0.11 respectively). However, parents with lower STAI scores did report using more emotion-focused and problem-focused coping strategies to manage their children's emotional distress caused by common stressors (r Z 0.37 and 0.40 respectively, $p < 0.05$)."
- "The analyses showed that the correlations between parent and medical staff ratings, and child self-report of procedural distress, were all statistically significant. There was a high correlation between the parent and staff ratings of the child's

distress and a lesser correlation between the children's self-report and the parent/staff perceptions."

- "A strong trend was found in the correlations that showed that parents who reported experiencing greater distress during the VCUG also reported that their children experienced greater procedural distress (r Z 0.27, $p < 0.07$). A similar trend was also found between medical staff ratings of parental anxiety and staff-rated child distress (r Z 0.28, $p < 0.07$)."
- "Analyses of the relationship between parent coping reactions to children's distress due to common stressors and children's distress ratings during the VCUG revealed that the children of parents who reported using more emotion-focused and problem-focused coping strategies to manage children's emotional distress were rated by medical staff as experiencing less procedural distress (r Z 0.30 and 0.33 respectively, $p < 0.05$)."
- "Also, increased parent use of emotion-focused and problem-focused coping was significantly related to the parents being rated by medical staff as less anxious during the procedure (r Z 0.40 and 0.31 respectively, $p < 0.05$) though surprisingly the parents themselves did not report feeling less anxious (r Z 0.6 and 0.17 respectively)."
- "Also, parents' emotion-focused and problem-focused coping was not significantly related to children's self-rated procedural distress (r Z 0.08 and 0.03 respectively)."
- "[S]ome children may feel very distressed but do not express that behavior overtly for the adults to observed, hence the lack of high correlations between the child and adult-perceived distress scales."
- "Surprising[ly] to us, neither age nor number of prior studies was useful as a predictor of post-procedure reported distress. This is, however, consistent with data reported by Volk Kernstock et al., who evaluated 31 children aged 2-8 years who had undergone first time and repeated studies."
- "Alternatively, the experience of watching your child undergo a VCUG (or wondering about the results) may be so significant that it affects even parents not prone to anxiety."

- "Further, although the act of catheterization likely causes the most acute pain, voiding while supine without normal privacy is also often stressful to toilet-trained children."
- "Another potential benefit of teaching coping strategies is long term. Children and their parents will likely experience many stressful, unpleasant situations. The strategies they are taught to be able to cope during a VCUG will likely be beneficial in other circumstances in the future."
- "The failure to find significant relationships between parent coping and child self-rated distress was unexpected...It may be that the sense of relief that some children experience immediately after completing the VCUG (which is when the child ratings were obtained) is so great that it might actually cloud their recollection of the distress they experienced during the procedure. To better address the question of perceived versus experienced distress, it would be useful in future work to examine the relations between child self-rated distress and behavioral indicators of child distress."

Sedation and the VCUG (United States)

- "A voiding cystourethrogram is **frequently a stressful procedure for pediatric patients, parents, and occasionally the radiology staff.** I believe most radiologists would agree with that statement but if doubt exists, there is research that supports it."

- "I was taught during residency and fellowship that the patient needs to be conscious for voiding and that the procedure is not painful. I believed it. I took pride in my ability to calmly wait and offer reassurance to parents that though their child was crying and screaming, the child was not really in pain and that it would be over in a few minutes. Sometimes, those minutes seemed like forever to everyone in the room."

- **“I see fear and anxiety daily when performing VCUGs**. In addition, the memory of previous painful experiences has effects on pain experience during subsequent procedures.”

- “I am offering sedation to more and more patients for VCUG and their parents seem grateful. This is because of increasing knowledge that **patient distress is real and can affect future medical procedures.**”

- “**Recent research in the area of pain medicine has revealed that high-anxiety and low-pain procedures such as a VCUG cause true distress to patients that can last beyond the time of this procedure.**”

Effects of parental soothing behavior on stress levels of 2-8 year old children during voiding cystourethrograms by phase of procedure (Austria, translated from German)

- “Using the example of a **voiding cystourethrogram (VCUG), a painful radiological procedure**, this study investigated whether parental soothing behavior… in one phase of the procedure influenced the child’s distress in the following phase.”

- “Parental reassurance during the anticipatory phase significantly increased the child’s distress of the following phase, while parental “sh sh” significantly reduced it. Both parental behaviors showed no significant effect on the child’s distress of the following phase when applied during the procedure itself. Results underline the importance of differentiating between anticipatory and procedural phases of the VCUG.”

Children, voiding cystourethrograms, and family perceptions (United States)

- “The American Academy of Pediatrics (1999) strongly recommends that young children receive a VCUG with their first febrile UTI.”

- “**The VCUG procedure may create distress in a child and the accompanying family members. A study be Zelikovsky indicated that the procedure is painful, invasive, and frightening for children and distressful for family members.**”

- "A **VCUG test can lead to patient and family related to perceived pain, fear, and distress before, during, and after the procedure**. Families that regard themselves with greater anxiety were more likely to perceive their child with more fear, distress, and pain. The most significant relationship was between high experienced anxiety and the family's perceptions of fear and pain in their children."

- "The study showed that most parents do not find the VCUG procedure as distressing as they had anticipated and the families' anxiety at the time of the procedure greatly influenced their perceptions of pain, fear, and distress perceived in their child. The discovery that most of the families would consent to a repeat VCUG and would likely be present substantiates the findings of this study."

2012

VCUG and the recurring question of sedation: preparation and catheterization technique are key (United States)

- Estimated 50,000 children are diagnosed with VUR after UTI each year in the United States; thus "the **number of children undergoing screening examinations (VCUGs), therefore, is likely in the many hundreds of thousands**."

- "**The vast majority of VCUG examinations are performed primarily on an outpatient basis, unfortunately often with little or no preparation of the child or parent. The VCUG examination can therefore be perceived as a painful investigation associated with high levels of distress and anxiety for the child, parents, and even the medical staff.**"

- "Unfortunately, **many children have been irreparably traumatized by previous catheterizations as well as other invasive medical procedures and the mere thought of undergoing an unknown or repeat procedure is unbearable.**"

- "...any radiologist who performs VCUG examinations has on occasion walked into the fluoroscopy suite only to find a shocked, distraught, or even angry parent who had no idea that their child was to undergo this type of examination. The test is either canceled.... Or the examination proceeds in an uncomfortable environment, more often than not resulting in a traumatic experience for the child and parent."

- "**When children and parents are well prepared and familiarized with the procedure, the majority of children will have little or no difficulty with catheterization.**"

- "Commands to use coping, inappropriate reassurance, apology, empathy, criticism, and giving control to the child by adults all promote child distress behavior during medical procedures. The only adult behavior that has been proven to have beneficial results with both child coping and distress are distraction techniques."

- The article goes on to mention several ways that the VCUG can be improved including preparation of parent and child with thorough explanations of the examination, use of lidocaine before catheterization, distraction techniques, and sedation in select cases where necessary.

- The article then says, disrespectfully to survivors, "If the argument is that sedation is primarily needed to prevent the stress and anxiety associated with invasive medical procedures in children, then how can we justify not routinely sedating for immunizations, blood draws, nasoenteric tube placement, lumbar punctures, etc. These procedures surely are equally as distressing to children." (These procedures are not equally as distressing, this is a baseless claim with no research backing it up.)

Parent perspectives of the VCUG: a three-part prospective survey study (United States)

- "**The VCUG is an invasive procedure that is uncomfortable and distressing for the pediatric patient**."

- 32 girls and 13 boys, all underwent VCUGs.
- "**Twelve parents (27%) reported having had no explanation about the VCUG by a healthcare provider. Fifteen percent of non-white interviewees had received an explanation compared to 84.9% of white interviewees.**"
- "Of the 35 parents who completed the 2-week post VCUG study, 11 **(31%) noticed changes in their child's behavior. Eight of these parents were worried about those changes."**
- "**We conclude that a significant number of parents are uninformed about the VCUG**, which influences their expectations for the procedure."

Urinary bladder rupture during voiding cystourethrography (South Korea, translated from Korean)

- "Bladder rupture is a rare complication of VCUG, and only a few cases were reported. Bladder rupture among healthy children during VCUG is an especially uncommon event."
- "Presented is a case of bladder rupture that occurred during a VCUG in a healthy 9-month-old infant, due to instilled action of dye by high pressure."
- "**Some reported complications of VCUG range from urinary discomfort, UTI to bacteremia, as well as bladder rupture**"
- The 9-month-old had grade II VUR in the right ureter and grade III VUR in the left ureter. The VCUG went according to plan but after the patient was tachypneic with a distended and tender abdomen. She was sent to the operating room for exploration and urine, blood clots, and contrast media had to be removed from the peritoneum. Approximately 3 cm long bladder rupture was found.

- "To perform a safe VCUG, we should pay attention to some factors such as bladder volume, the patient's underlying disease, the velocity of the contrast instilled, and catheter size."

- "The bladder volume is different among individuals, and the bladder dome which is the weakest part of bladder can easily be ruptured when excess volume is injected rapidly."

- "In this case, the main causes of bladder rupture are considered to be the use of the Foley catheter instead of a feeding tube, manual injection of contrast media, and the excess volume instilled more than expected volume."

2013

Analysis of an intervention to reduce parental anxiety prior to VCUG (United States)

- "The VCUG is a common imaging test in pediatric urology that can be associated with anxiety in the child and parent."

- "Parental state anxiety was higher before the procedure than after the procedure. Younger parents had greater pre-procedure state anxiety. Contrary to our expectations, pre-procedure state anxiety did not differ between control and experimental groups. However, parents in the experimental group demonstrated less anxiety with some individual items in the questionnaire"

- "An educational brochure mailed to families prior to VCUG did not decrease pre-procedure parental state anxiety. However, the educational brochure can ensure accurate dissemination of information to help families prepare for this potentially distressing procedure."

Efficacy of a cartoon and photograph montage storybook in preparing children for voiding cystourethrogram

- "Undergoing voiding cystourethrogram (VCUG) can be distressing for children"

- "The cartoon and photograph montage storybook format of preparing children for VCUG was effective in increasing their tolerance for the procedure. The storybook should be mailed out in advance because the **majority of families did not pursue information on preparing their children for VCUG**."

2014

Subsequent cancer risk of children receiving post voiding cystourethrography; a nationwide population-based retrospective cohort study (Taiwan, translated from Chinese)

- 31,908 participants under 18 who underwent a VCUG between 1997 and 2008 and a non-VCUG group of participants
- The **overall cancer risk of the VCUG cohort is 1.92-fold higher than the non-VCUG cohort**
- The **genital cancer and urinary system cancer risks of the VCUG cohort were 6.19-fold and 5.8-fold higher than the non-VCUG cohort**
- Conclusion: "**Pediatric VCUG is associated with increased subsequent cancer risk, especially in the genitourinary system**"

Oral Midazolam for voiding dysfunction in children undergoing VCUG: a controlled randomized clinical trial (Iran, translated from Persian?)

- 84 children were split into 2 groups (control and midazolam group)
- "The use of midazolam 0.5 mg/kg reduced children's stress and increased their cooperation during the procedure"
- "**Although the side effects of VCUG are not common, they are important. These complications that can occur in both sexes include UTI, hematuria, cystitis and**

urinary dysfunction following a catheterization, phobia of urination, nocturia, and stopping urination."

- "In the literature, **psychological trauma resulting from VCUG was considered the same as from a violent rape, especially in girls**"

Children's memory in "scientific case studies" of child sexual abuse: a review (United States)

- "One **painful and potentially embarrassing procedure involving genital penetration is VCUG**. Results from studies examining children's memory for VCUG reveal that, although young children can accurately report details of the procedure, more distressed children tend to report fewer details in free recall."

The accuracy and health risks of a voiding cystourethrogram after a febrile urinary tract infection (April 2014)

- Physicians often defer obtaining a voiding cystourethrogram (VCUG) after the diagnosis of urinary tract infection (UTI) due to concerns ***regarding increased health risks and inflated rates of vesicoureteral reflux (VUR)***. **This study examines the health risks and accuracy of VCUG testing after diagnosis of a febrile UTI**.
- The incidence and severity of VUR were similar in patients that underwent early and late VCUG testing. Patients who underwent early VCUG testing showed no sign of worsening illness after the test was performed. During the 5-year follow up, **these patients did not have higher rates of return emergency department visits or hospital readmission compared to those who received late VCUG testing**.
- The rate of VUR detection does not increase with early VCUG testing. **Early VCUG testing does not lead to increased risk of bacterial dissemination or urosepsis**.
- UTI is one of ***the most common and serious types of bacterial infection in children***. Estimates on cumulative incidence in American children indicate that up to

180,000 of the annual birth cohort will be diagnosed with a UTI by 6 years of age (**3–7% of females** and 1–2% of males). In 1999, the American Academy of Pediatrics (AAP) issued practice guidelines for the management of UTI. These guidelines recommend that young children undergo a renal ultrasound and VCUG to evaluate for the presence of anatomic abnormalities and VUR after they are diagnosed with their first UTI.

- **The AAP guidelines do not suggest when a VCUG should be performed**. The guidelines state that a VCUG should be obtained **'at the earliest convenient time'**, once a child is free of infection and bladder irritability is absent. Traditionally, there have been concerns about ***the accuracy and safety of a VCUG performed during an active infection***.
- Because UTIs can cause ureteral dilatation and inflammatory changes at the ureterovesical junction, **they may cause transient VUR**. Therefore, a VCUG performed during infection may falsely overestimate clinically relevant VUR. Moreover, there are concerns that **catheterization during a VCUG may damage the already inflamed urinary tract mucosa**, and **prolong a UTI or lead to bacterial dissemination and sepsis**. Consequently, many physicians defer VCUG testing **until the UTI resolves**. **The aim of this study was to explore the issues of timing, safety, and accuracy of VCUG testing**.
- When examining patient and cohort demographics, there was seen to be a **female preponderance in the outpatient group** compared to the inpatient group.
- In our study, all patients were followed for 5 years after hospital discharge. After hospital discharge, **24% of patients scheduled for an outpatient VCUG did not undergo testing**. McDonald et al. reported **a similar pattern of patient non-compliance**.
- These results **support published evidence** suggesting that **VUR does not increase the risk of recurrent UTIs**.
- The authors recognize that this study is limited by its small sample size and retrospective nature. Because of the retrospective nature of this study and the available data, we cannot report whether patients required more sedation with early

VCUG testing or developed less serious complications like increased anxiety, increased pain, hematuria, dysuria, urinary frequency, urgency, or flank pain. We were not able to determine if the resolution of VUR is affected by timing of VCUG. We also cannot report if patients presented to other hospitals for further evaluation after VCUG testing. Finally, we were not able to determine if there is a higher incidence of renal scarring, renal insufficiency, or hypertension in patients that did not have a VCUG.

- **Our results indicate that early VCUG testing for a first febrile UTI is accurate and does not lead to significant health risks in healthy children.**

2015

The NICHD Protocol: A Review of an Internationally-Used Evidence-Based Tool for Training Child Forensic Interviewers (Ontario, Canada)

This study discusses the standard protocol for interviewing child sexual abuse victims.

- "The procedure (Voiding Cystourethrogram, or VCUG) involves taking X-rays while children urinate to identify potential kidney problems and infections. In the study, children were interviewed one to five years after experiencing this procedure (children interviewed at shorter delays tended to recall more details of the experience, but delay did not significantly affect inaccuracies)."

- **"Although the procedure involved invasive genital contact and was quite distressing for most children, those who had the procedure when they were 2 and 3 years old had little to no memory for the experience, in contrast to nearly all children 5 to 7 years old.** Taken together, the implications of these findings are

that older children and adults are highly unlikely to remember detailed events that occurred prior to age 3."

Renal tract abnormalities missed in a historical cohort of young children with UTI if the NICE and AAP imaging guidelines were applied (United Arab Emirates)

- "The **AAP guidelines would have missed 56% of the children with VUR >= grade II**, including a high proportion of grades IV and V VUR, and all children with renal scarring as well as those with decreased renal uptake."
- "The **prevalence of renal tract abnormalities missed by the new guidelines is high**."

2016

The voiding cystourethrogram: minimizing patient and parent distress in an invasive radiologic procedure (United States)

- "The **VCUG can be considered one of the more distressing invasive procedures that children may experience in the outpatient setting**."
- "**Due to the invasiveness of catheterization and the command to void in public, VCUGs can involve high levels of psychological and physical distress for the child**"
- "While the VCUG is considered the standard of investigation for diagnosing reflux in children, **less attention has been paid to the stressful effect of this potentially painful procedure**. Many aspects of the VCUG can be experienced as distressing to both the child and their parents. The anticipated anxiety of the procedure, the examination of the child's genital area by a stranger, the insertion of a catheter into the child's body, the embarrassment of lying uncovered on an exam table, and the

command to urinate in front of those present in the exam room are all aspects of the VCUG that create the possibility for distress in the child."

- "...**voiding on the exam table may be experienced as particularly traumatic for younger children who have recently been toilet-trained**"

- "The VCUG renders the child dependent on those in the room, as **they may be separated from their parents and their legs may be forced apart and held down**."

- "**The overall perception in healthcare is that the VCUG is a short and painless procedure, despite evidence that it is distressing to children**. In one study, parents tended to rate their child's distress and their own distress as higher than the staff ratings, indicating that parents see this procedure as having a significant impact on their child's level of distress. In another study, **27% of the children were found to have high scores indicating severe distress** on a scale measuring their reaction to the procedure."

- **"In invasive procedures, children who experience high levels of pain and behavioral distress tend to form negatively exaggerated memories that later predict children's pain and distress in future procedures. Additionally, children with negatively exaggerated pain memories are at risk for developing medical phobias and avoidance of medical care as adults**."

- "**Children retain memories of their VCUG experience and that those who had a distressing experience can replay precisely the aspects of the procedure they found most traumatic, thereby affecting their emotional well-being in the long-term.**"

- "**The long-term effects of the VCUG are perhaps most evident in the behaviors that children display in the weeks and months after the procedure. Gebarski (2013) found that behavioral changes, clinging to parents and disturbances in toilet-training and sleep routines were common after a child experienced a VCUG**. In another study, **1/3 of parents reported behavior changes in their child**

after the procedure, including difficulty passing urine, a fear of medical personnel, and general irritability…. From this evidence, **it is possible to conclude that the level of distress experienced during a VCUG can significantly influence children's behavior in the long-term.**"

- "Restriction of a child's mobility is a common feature of pediatric care, especially during invasive procedures. Restriction can be defined as a practice that occurs when risk-benefit favors immobilization for the purpose of delivering safe and timely care to the child. Among nursing and other clinical staff, restriction is so commonplace during procedures that often staff do not realize that they are doing it."

- "**Research shows that restriction can impact children in negative ways in the long-term. Restriction has been linked to speech delays, high rates of recall of the distressing procedure, and raised cortisol levels after a procedure is finished**….. Overall, causing distress to a child, even with potential clinical gain, is **something that should be avoided by all healthcare professionals**."

Distress experienced during pediatric VCUGs – a granular, prospective assessment using the brief behavioral distress scale (United States)

- "**In spite of decades of experience with the procedure, controversy persists as to the overall distress experienced by children and the routine need for sedation in children undergoing VCUGs**."

- "At the root of these issues are some of the limitations of previous studies as most incorporate inherently subjective parental questionnaires to determine distress levels rather than using an objective, unbiased observer."

- "We find that despite there being significantly increased distress during the catheter insertion and full bladder phases, the distress levels during VCUGs are markedly less than in previous reports. Even the most distressful stage, catheterization, was less stressful than previously reported with levels closer to that of minor distress evinced

by comfort-seeking behavior from a parent rather than more significant distress resulting in screaming."

Variation in the level of detail in pediatric voiding cystourethrogram reports (United States)

- "VCUG provides a wealth of data on urinary tract function and anatomy, but few standards exist for reporting VCUG findings."
- "We analyzed original VCUG reports from children enrolled in the randomized intervention for children with vesicoureteral reflux trial (RIVUR). A 23-item checklist was created and used to evaluate reporting of technical, anatomic, and functional information."

- 602 VCUGs were performed at 90 different institutions

- "76% were read by a pediatric radiologist, and 49% were performed at a FSPH (free-standing pediatric hospital). On average, less than half of the 23 items in our standardized assessment tool were included in VCUG reports. **The completeness of reports varied by facility type: 51% complete at FSPH, 50% at PHWH (pediatric "hospital within a hospital"), 36% at NPH (non-pediatric hospital), and 43% at ORF (outpatient radiology facility).**"

- "**There is a substantial underreporting of findings in VCUG reports** when assessing a widely represented sample of routine, community-generated reports using an idealized standard. Although VUR was often reported, other crucial anatomic and functional findings of the VCUG were consistently underreported across all facility types."

Establishing a Standard Protocol for the Voiding Cystourethrography

- VCUGs are ordered by **many** specialists and primary care providers, including pediatricians, family practitioners, nephrologists, hospitalists, emergency department physicians, and urologists. ***Current protocols for performing and***

interpreting a VCUG are based on the International Reflux Study in 1985. However, more recent information provided by many national and international institutions suggests a need to refine those recommendations.

- In addition, a recent survey directed to the chairpersons of pediatric radiology of 65 children's hospitals throughout the United States and Canada ***showed that VCUG protocols vary substantially***. Recent guidelines from the American Academy of Pediatrics (AAP) recommend a VCUG for children between 2 and 24 months of age with urinary tract infections **but did NOT specify how this test should be performed**. To improve patient safety and to standardize the data obtained when a VCUG is performed, the AAP Section on Radiology and the AAP Section on Urology initiated the current VCUG protocol to create a consensus on how to perform this test.

The role of voiding cystourethrography in the investigation of children with urinary tract infections

- "Voiding cystourethrography (VCUG) is the radiographic test of choice to diagnose VUR. Due to its **invasive nature and questionable benefit** in many cases, the American Academy of Pediatrics (AAP) no longer recommends VCUG routinely after an initial febrile UTI"

- "Of children presenting with a febrile UTI, 25-40% are found to have vesicoureteral reflux (VUR)."

- "...many children underwent invasive surgical procedures to correct VUR. We now know that many cases of VUR are low-grade and have a high rate of spontaneous resolution."

2017

Contemporary Practice Patterns of Voiding Cystourethrography Use at a Large Tertiary Care Center in a Single Payer Health Care System

Voiding cystourethrogram ***involves radiation exposure and is invasive***. Several guidelines, including the 2011 AAP (American Academy of Pediatrics) guidelines, ***no longer recommend routine voiding cystourethrogram after the initial urinary tract infection in children***. **The recent trend in voiding cystourethrogram use remains largely unknown**. We examined practice patterns of voiding cystourethrogram use and explored the impact of these guidelines in a single payer system in the past 8 years.

Controversies regarding management of vesicoureteric reflux (India)

- "Vesico-ureteric reflux (VUR) is diagnosed in 30-40% of children imaged after first febrile UTI."

- "The 'top-down' approach involving ultrasound and dimercaptosuccinic acid scan (DMSA) first after an appropriate interval following UTI, can help in **avoiding voiding cystourethrogram (VCUG), an invasive test with higher radiation exposure**."

- The primary goal in the management of a child with urinary tract infection (UTI) is to prevent recurrence of UTI and acquired renal damage. Approximately 15% of children develop renal scarring after a first episode of febrile UTI. Vesico-ureteric reflux (VUR) is diagnosed in 30-40% of children imaged after first febrile UTI. The 'top-down' approach involving ultrasound and dimercaptosuccinic acid scan (DMSA) first after an appropriate interval following UTI, can help in avoiding voiding cystourethrogram (VCUG), an invasive test with higher radiation exposure. The majority view remains that VCUG should be done after the second attack of UTI in girls and first attack of UTI in boys. Although the evidence in favour of antibiotic prophylaxis remains doubtful in preventing renal scars associated with VUR, it remains the first line treatment for high-grade reflux (grade 3-5) with an aim to prevent UTI and allow spontaneous resolution of VUR. Early identification and appropriate treatment of associated bowel bladder dysfunction is an

essential part of successful medical management of VUR. Endoscopic treatment of VUR, using a bulking agent, is useful in grade 3 VUR. The main controversy regarding intervention (endoscopic/open surgical intervention) involves absence of strong evidence for these interventions in reducing renal scarring on randomized controlled trials. However, several recent trials have found the surgical interventions to be effective in reducing recurrent pyelonephritis and repeated hospital admissions.

Use of sedative drugs at reducing the side effects of voiding cystourethrography in children

- "Although technological progress goes toward less invasive approaches, some of the current methods are still invasive and annoying."
- "**VCUG is a distressful procedure that gives serious anxiety and pain in a large proportion of children** and fear for parents; therefore, using effective sedative drugs with the least side effects is necessary"

Local Trends in the Evaluation and Treatment of Urinary Tract Infections and Vesicoureteral Reflux in Children

- "The management of urinary tract infection in children has changed in the last decade **due to worries about antibiotic overuse, and the trauma and radiation of voiding cystourethrograms**."
- "There was a **dramatic decrease in the number of voiding cystourethrograms** performed from 907 in 2005 to 216 in 2013."

Urinary Tract Infections after voiding cystourethrogram

- "Reported rates of post-procedural urinary tract infection (ppUTI) after voiding cystourethrogram (VCUG) are highly variable (0–42%)"

- "This study demonstrated that the risk of ppUTI after a cystogram is very low (1.0% in this cohort). Having a pre-existing urologic diagnosis such as VUR or hydronephrosis was associated with ppUTI"

Urinary tract infections in children: Diagnosis, treatment, imaging - Comparison of current guidelines (Poland)

- "An analysis was performed of the guidelines from: American Academy of Pediatrics (AAP), National Institute for Health and Care Excellence (NICE), Italian Society of Pediatric Nephrology, Canadian Paediatric Society (CPS), Polish Society of Pediatric Nephrology, and European Association of Urology (EAU)/European Society for Pediatric Urology (ESPU)."

- "There was still a **lack of sufficient data to formulate coherent, unequivocal guidelines** on UTI management in children, with **imaging tests remaining the main area of controversy.**"

Critical appraisal of the top-down approach for vesicoureteral reflux (United States/Egypt)

- "Traditionally, it was mistakenly believed that every reflux should be identified and promptly treated to prevent UTI and minimize the risk of renal damage."

- "VCUG remains the gold standard tool to identify VUR. However, the **test is usually a traumatic experience to both patients and their families** due to the need for catheterization. Additionally, it carries a **risk of introducing infection into the urinary tract**. More importantly, **it identifies a population with clinically-insignificant VUR that may never come to clinical attention leading to potential overtreatment**."

2018

Pediatric voiding cystourethrography: an essential examination for urologists but a terrible experience for children (Japan, translated from Japanese) (FULL TEXT HERE)

- "This **invasive procedure imposes a significant burden on children and their parents.**"

- "In some countries, including Japan, **VCUG is mainly carried out by young urologists, but if they are inexperienced, patients experience more distress and anxiety.**"

- "**VCUG is painful and unpleasant**, with urethral catheterization and voluntary voiding in public. After catheterization and filling the bladder with contrast medium, the patient must void in front of the X-ray camera, which causes anxiety for patients and families. **More than half the children undergoing VCUG remember it as worse than VUR surgery**. This is an extremely humiliating experience for toilet-trained children, because they are educated to void in the restroom."

- "Children's developing tissues and organs are approximately 10-fold more sensitive to ionizing radiation than adults, and mean risks for hereditary effects and cancer after VCUG during childhood have been estimated at 15 per million and 125 per million, respectively. Thus, **radiation risks associated with VCUGs are NOT negligible**."

- "Performance of VCUG should be reserved for those occasions when the results would affect VUR management to determine the requirement for surgical intervention."

- FULL TEXT LINKED HERE. "Voiding cystourethrography is the most important fluoroscopic examination in pediatric urology for the investigation of lower urogenital tract diseases, such as vesicoureteral reflux or urethral stricture. **However, this invasive procedure imposes a significant burden on children and their parents,**

and recently there has been a paradigm shift in the diagnosis and treatment of vesicoureteral reflux. In the 2011 revision, the American Academy of Pediatrics guidelines on urinary tract infection recommended abandoning routine voiding cystourethrography after the first febrile urinary tract infection. In 2014, the randomized intervention for children with vesicoureteral reflux study recommended discontinuation of routine continuous antibiotic prophylaxis for vesicoureteral reflux. **The time is now ripe to radically reconsider indications for voiding cystourethrography and the procedure itself**."

Pediatric cystogram: are we considering age-adjusted bladder capacity? (Eastern Ontario)

- "Generally, bladders tended to be overfilled with 32% more volume in mL than the expected age-adjusted bladder capacity."
- "Bladders are filled above the estimated age-adjusted capacity in mL at the following rates: 32% in the whole group and 64% in infants undergoing VCUG. It raises concern of possible bladder rupture in this age group. Furthermore, this may lead to overgrading and over diagnosing of vesicoureteric reflux."

Vesicoscopic cross-trigonal ureteral reimplantation: High success rate for elimination of primary reflux (United States)

- "Vesicoscopic ureteral reimplantation is an approach that completely recreates all aspects of open cross-trigonal repair. **Complications were uncommon and success rates were very high** in the current study."

2019

New trends in voiding cystourethrography and vesicoureteral reflux: who, when, and how? (United States)

- "The literature has shown significant variability among institutions regarding the VCUG protocol used, as well as inconsistent reporting of the findings from the VCUG between institutions"

- "Given the **invasive and relatively unpleasant nature of a VCUG**, it is important that as much information as possible is obtained and reported when these studies are carried out."

- "In addition to potential patient and parental distress associated with a VCUG, it also exposes the child to radiation, albeit at low doses."

- "Sedation or immobilization can be considered as long as these methods do not alter the ability of the child to void, which will impact the test outcomes. Patient and caregiver education, as well as a comfortable environment with child life specialists, have also been shown to reduce the stress associated with invasive testing."

- "Although the benefits generally outweigh the risks, it is logical to optimize the quality and consistency of data obtained from each VCUG, as it is an invasive study"

- "Recent standardization of the VCUG protocol has created a consensus on how to best carry out this test."

Adherence to the 2011 American Academy of Pediatrics Urinary Tract Infection Guidelines for Voiding Cystourethrogram Ordering by Clinician Specialty

- **Guideline adherence was more likely among urologists/nephrologists than pediatricians/others** and was not associated with abnormal voiding cystourethrogram among children 2-24 months. ***Multicenter evaluation is necessary to determine if ordering recommendations should be revised***.

Population-based trend analysis of voiding cystourethrogram ordering practices in a single-payer healthcare system before and after the release of evaluation guidelines

- "While voiding cystourethrogram (VCUG) is a widely-accepted test, it is invasive and associated with radiation exposure. Most cases of primary vesicoureteral reflux (VUR) are low-grade and unlikely to be associated with acquired renal scarring. To select patients at greatest risk, in 2011 the American Academy of Pediatrics (AAP) published guidelines for evaluation of children ages 2 - 24 months with urinary tract infections (UTIs)."

- "Trend analysis demonstrated that the total number of VCUGs ordered in the province has **decreased over a decade** (Figure 1), with a concurrent decrease in VUR diagnosis. On multivariate regression analysis, the decrease in VCUG ordering could not be explained by changes in population demographics or other baseline patient variables. Most VCUGs obtained per year were ordered by pediatricians or family physicians (mean 2,022+523.8), compared with urologists and nephrologists (mean 616+358.3). **Interestingly, while the rate of VCUG requests decreased, the annual number of surgeries performed for VUR (endoscopic or open) did not show a significant reduction over time**."

- "We present a large population-based analysis in a universal access to care system, reporting a decreasing trend in the number of cystograms and differences by primary care versus specialist providers. **While it is reassuring to see practice patterns favorably impacted by guidelines, it is also encouraging to note that the number of surgeries has remained stable. This suggests that patients at risk continue to be detected and offered surgical correction**. These data confirm previous institution-based assessments and **affirm changes in VCUG ordering** independent of variables not relevant to the healthcare system, such as the insurance status."

2020

Minimizing the risk of psychological trauma during pediatric voiding cystourethrogram (United States?)

Can virtual reality help children undergoing urologic procedures? (United States)

- "**A VCUG can be very distressing for young children and many of them are unable to get through the exam while awake.**"

Pediatric Imaging, Journal of the Korean Society of Radiology (South Korea, translated from Korean)

- "Psychological preparation: Apart from physical preparation, psychological preparation is necessary for both, patients and parents as they may be anxious due to fear of pain and unknown, urethral catheterization, and radiation use."
- "Parents are recommended to stand beside their children for comforting them during the procedure. If the patient's mother is pregnant, she is advised to be with the patient only during catheter insertion."

2021

Evaluation of the Diagnostic Value of Contrast-Enhanced Voiding Urosonography with Regard to the Further Therapy Regime and Patient Outcome-A Single-Center Experience in an Interdisciplinary Uroradiological Setting

- Vesicoureteral reflux (VUR) describes a common pediatric anomaly in pediatric urology with a prevalence of 1-2%. In diagnostics, in addition to the gold standard of voiding cystourethrography (VCUG), **contrast-enhanced urosonography (ceVUS) offers a radiation-free procedure, which, despite its advantages, is NOT yet widely used**.

- Between 2016 and 2020, 49 patients were retrospectively included and received a ceVUS to evaluate VUR. With a distribution of 47:2 (95.9%), **a clear female predominance was present**.

- Results: Compared to intraoperative findings, ceVUS shows a sensitivity of 95.7% with a specificity of 100%. Allergic reactions to the contrast medium could not be observed. Conclusion: With its high sensitivity and intraoperative validation, **ceVUS offers an excellent alternative to VCUG, the gold standard in the diagnosis of VUR. In addition, ceVUS is a radiation-free examination method with a low risk profile that offers an exceptional diagnostic tool** in the diagnostic clarification of recurrent urinary tract infections with the suspected diagnosis of VUR and should also be included in the consideration of a diagnosis next to the established VCUG, ***especially in younger children***.

Safety assessment and diagnostic evaluation of patients undergoing contrast-enhanced urosonography in the setting of vesicoureteral reflux confirmation

- There are **many** diagnostic options available, including voiding cystourethrography (VCUG) and contrasted-enhanced urosonography (ceVUS). ceVUS combines a diagnostic tool with a high sensitivity and specificity which, according to previous study results, **was even shown to be superior to VCUG**.

- Nevertheless, despite the recommendation of the EFSUMB, the ceVUS has not found a widespread use in clinical diagnostics in Europe yet.

- Materials and methods: Between 2016 and 2020, 49 patients **with a marked female dominance** (n = 37) were included.

- The 49 patients included in the study showed no adverse effects. 51% of patients (n = 26) were referred with the initial diagnosis of suspected VUR, while 49% of patients (n = 23) came for follow-up examination or to rule out recurrence of VUR. The vast majority had at least one febrile urinary tract infection in their recent medical history (n = 45; 91,8%).

- Conclusion: ceVUS is an examination method **with a low risk profile which represents with its high sensitivity and specificity an excellent diagnostic tool** in the evaluation of vesicoureteral reflux, ***especially in consideration of a generally very young patient cohort***.

Hi Shelby,

I spoke with our Pediatric Radiology Section Chief and he indicated that we do VCUG exams at Cook Children's Medical Center. PIC cystograms are only done by urology practices and involves a scope, anesthesia, etc. We do not currently offer ceVUS at this time.

Thank you,
David

Parents' perceptions of the impact of information at a VCUG of their child: an example of person-centered care in radiography (Sweden, translated from Swedish)

- "The **VCUG is associated with a high level of distress for both the child and the parents.**"
- "According to the United Nations Convention on the Rights of the Child (1989) and the Swedish Patient Act, the best interest of the child must be considered"
- "Regarding VCUG, it has been reported that a parent who is more distressed affects the stress level of the child negatively. Hence, it is important that parents receive adequate information so that they can prepare themselves and thus focus on their child's best interest during the examination"
- "According to the standard of care (Sweden), before the VCUG examination, an appointment letter about the examination, including a reference to a website, was sent to the parents of the child who was scheduled for the examination. The letter briefly described the examination procedure, and the website provided detailed information.... Parents were requested to telephone the radiology department before

the VCUG examination date after receiving the appointment letter. During the phone call, the procedure information was repeated with an opportunity to ask questions. The information was also reviewed verbally by a radiology nurse in the waiting room, and the parent was encouraged to ask any questions for further clarification."

- "Receiving written and then verbal information over the phone before arriving at the department helped parents to understand what would be happening and was perceived as significant. By reading educational materials and being given the opportunity to ask questions, the parents could better prepare the child and themselves psychologically, emotionally, and physically for the upcoming examination."

- **Direct quote from parent: "I got to talk to a nurse, who describing a little how, what would be required of me as a parent, and it was rather nice because then I could mentally prepare myself that this was going to be difficult."**

Standardized protocol for voiding cystourethrogram: Are recommendations being followed? (United States)

- This study highly advocates for the VCUG procedure but anyone who has experience reading and analyzing research articles could see that this study is poorly designed and incredibly biased.
    - Internal Validity
        - Cohort not recruited in an acceptable way (not representative of the population of individuals who receive VCUGs): "Studies performed on patients >18 years of age and **those obtained for trauma evaluation were excluded from study**." - Authors also fail to explain why they made the choice to exclude these individuals.
        - The above quotation also indicates that the authors exhibited selection bias

    - External Validity
        - Results indicate that: “Timing of reflux [which would be revealed through VCUG] has been shown to predict likelihood of spontaneous resolution and risk of breakthrough urinary tract infection; thus, its omission may limit the information used to counsel families and provide individualized care.” **However**, as the results are not representative of the whole population of individuals who receive VCUGs, they **cannot** be applied to the whole population of individuals who receive VCUGs. Someone reading this research article may easily wrongly assume that these results are applicable to all individuals receiving VCUGs if they skip over the methodology section of the article.

- This serves to provide supporting evidence that physicians and researchers are aware of the trauma caused by VCUGs yet actively choose to ignore it

Contrast-enhanced voiding urosonography in the assessment of vesical-ureteral reflux: the time has come

- “During the last 20 years, the diagnostic approach to this entity has passed through several, drastic changes: indeed, since its introduction in 1994 contrast-enhanced voiding urosonography (ceVUS) has gradually accompanied the voiding cystourethrography (VCUG) as alternative imaging technique for the diagnosis and staging of VUR. Despite a large number of papers has strongly encouraged its use in clinical practice, due to the lack of ionizing radiations and its high sensitivity rate, to date almost all the guidelines only include the VCUG for VUR diagnosis.”

Characteristics and outcomes of patients receiving sedation for voiding cystourethrography

- “Voiding cystourethrogram (VCUG) is used to diagnose vesicoureteral reflux (VUR); however, it is an **invasive procedure and can be psychologically distressing.**”

- "There were **no significant differences in VCUG results between sedated and non-sedated patients**.... Procedural sedation did not have a significant impact on test results, suggesting its potential utility in relieving pain and anxiety associated with VCUG."

2022

Safety and parents' acceptance of ultrasound contrast agents in children and adolescents – contrast enhanced voiding urosonography and contrast enhanced ultrasound (Germany)

- "The parents would agree with the use of both ceVUS and CEUS as a diagnostic tool again in 96% (54/56) or 100% (30/30) of the cases, respectively and **92.9% (52/56) would prefer ceVUS to voiding cystourethrography (VCUG)**."

- "The **vast majority of parents prefer ceVUS and CEUS to VCUG**, CT or MRI because of the safety profile of the contrast agent and diagnostic accuracy."

Interdisciplinary collaboration in a pediatric urology outpatient clinic at a tertiary children's hospital: a case series (United States)

- "**Access to a psychosocial support staff** can improve adherence to medical treatment by reducing barriers to care and promoting behavioral change, **support patients in coping and reducing post-traumatic stress following surgery and invasive procedures**, improve communication between patients, families, and medical staff, and treat psychological issues that contribute to urinary symptoms."

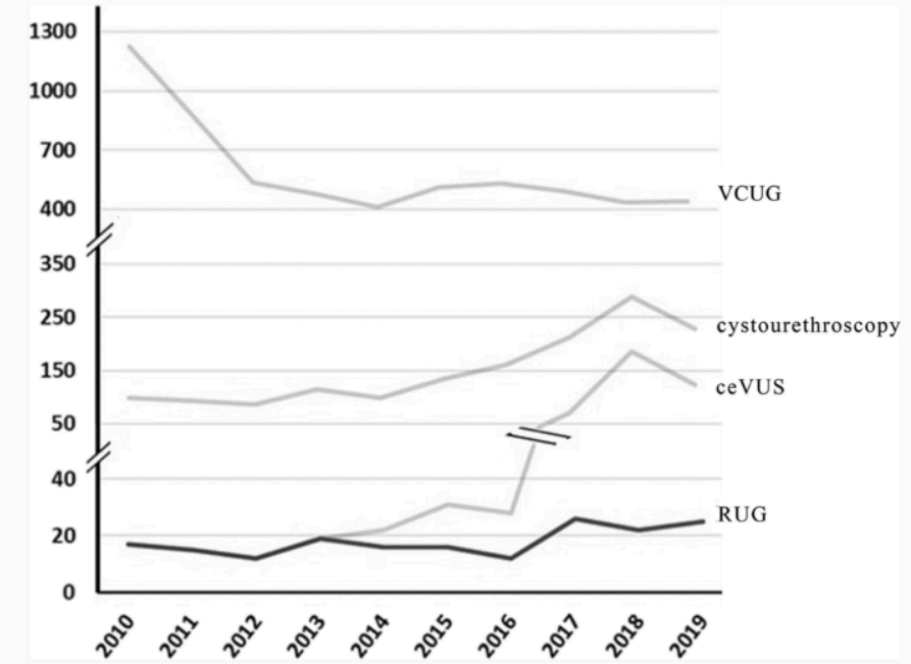
2023

Pilot study from University of Pennsylvania Masters of public health graduate student (United States)

- 10 VCUG survivors and 11 non-VCUG participants
- The VCUG group saw themselves as unhealthier and had more feelings/diagnosis of depression and PTSD
- Nobody in the non-VCUG group experienced shy bladder, overactive bladder, or urinary retention. These were prevalent in some way within the VCUG group
- The VCUG group showed pelvic dysfunction, while the non-VCUG group did not
- **81% of the non-VCUG group has had a pap smear compared to 44% of the VCUG group**. 50% of the VCUG group has never seen a gynecologist and don't plan to go
- The **VCUG group felt less comfortable receiving hugs from loved ones, especially parents**.
- Nearly all members of the VCUG group agreed they had experienced medical trauma as a child, agreed that their bodies were disrespected as children, strongly believed that their parents and doctors did not make the right choices for their medical care, and felt inherently less understood.
- The VCUG group experienced more nightmares, restlessness, odd bodily sensations, and intense pre-bedtime rituals.

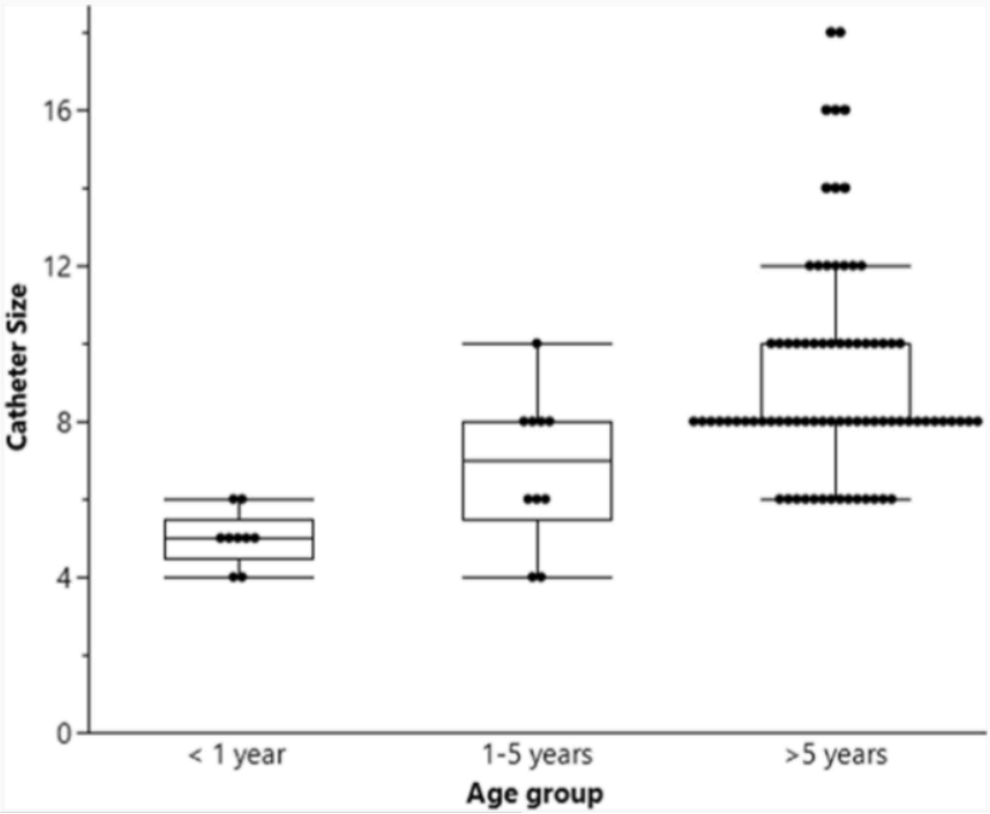
Retrograde urethrography in children: a decade of experience at a children's hospital (United States)

Fig. 2



- Graph above shows frequency of retrograde urethrography (RUG, median: 17/year), contrast-enhanced voiding cystourethrography (ceVUS, median: 70/year), cystourethroscopy (median: 104/year), and voiding cystourethrography (VCUG, median: 511/year) over a ten year period (with 2020 excluded due to COVID-19)

Fig. 3



- Graph shows average catheter size for children of various age groups
- "Technical difficulties were reported in 14 children (8%): inadequate catheter seal with suboptimal urethral distention (9) and significant pain (5)."
- "In 100 children… cystourethroscopy/VCUG were performed in conjunction with RUG and were used as gold standard references. Cystourethroscopy/VCUG showed pathology in 34 children and was normal in 66 children"
- "Some radiologists might rely solely on VCUG for evaluating all urethral, bladder, and reflux abnormalities without performing RUG… Radiologists should be aware that VCUG alone might not accurately demonstrate certain abnormalities of the male anterior urethra because the urethra is not fully distended to the degree seen on RUG"

An innovative diagnostic procedure in children: videourodynamics with contrast-enhanced voiding urosonography (Italy)

- "This technical report aims to describe a new modality of VUD in children by **replacing fluoroscopic VCUG with contrast-enhanced voiding urosonography (ceVUS)**. ceVUS using second-generation contrast media and harmonic imaging is a radiation-free and highly sensitive imaging modality used to detect VUR in children."
- "This article describes the advantages of this method compared with a conventional technique. In addition to being radiation-free, this procedure of advanced videourodynamics method **can better detect vesicoureteral reflux and intrarenal reflux combined** with urodynamic disorders associated with VUR."

Urinary tract infection in children: A narrative review of clinical practice guidelines (international review)

- "Febrile infants with UTI should undergo RBUS [renal and bladder ultrasound]. **VCUG should not be performed routinely after the first febrile UTI**; **VCUG** is **indicated if RBUS reveals hydronephrosis, scarring, high-grade VUR, or obstructive uropathy** as well as atypical or complex circumstances."
- "VCUG was recommended routinely for children between 2 months and 2 years **but not anymore**"
- Study looks at the guidelines concerning UTIs and demonstrates different places having different guidelines. For example:
    - One place: "VCUG: not routinely recommended after first UTI"
    - Another place: "VCUG is recommended after first UTI or abnormal RBUS or if the bacterial organism other that *E. coli*"

- "Voiding cystourethrography (VCUG)/micturating cystourethrogram is an **invasive study** that is **still considered the gold standard for excluding or confirming VUR and for assessing the degree of VUR**. It should be performed after the first febrile UTI if the ultrasound suggests either high-grade VUR or obstructive uropathy. Furthermore, it is indicated after a second episode of febrile UTI, atypical and recurrent infections in children <2 years of age and in older children, if there is abnormal voiding, which needs to be evaluated for voiding dysfunction with postvoid residual test and referral to urology before they have a VCUG. Likewise, it is indicated if hydronephrosis or thick bladder wall was found on RBUS, non-*E. coli* infection or family history of VUR were noted. **The concept of limiting indications for VCUG and dimercaptosuccinic acid (DMSA) scanning is due to significant radiation exposure, catheter risk-induced UTI, stress for young patients and their parents, and considering the cost of imaging techniques.**

- Where accessible, a **nuclear cystogram (NCG) may be used instead of VCUG to evaluate VUR** using radioisotopes. It offers a lesser amount of radiation than VCUG but provides poor anatomical detail for the male urethra, so it may miss posterior urethral valves. Using NCG as the initial test for female VUR investigation and in follow-up studies for both genders is reasonable."

***Utility of Positional Instillation of Contrast Cystography for Diagnosing Occult Vesicoureteral Reflux in Children: A Report of Two Cases* (Japan)**

- "Positional instillation of contrast (PIC) cystography is effective for detecting occult vesicoureteral reflux (VUR), which can not be revealed by standard voiding cystourethrography (VCUG)."
- "**PIC cystography is useful for** detecting occult VUR in children with negative VUR findings on standard VCUG or **who are unable to tolerate standard VCUG**."

Viability of contrast-enhanced voiding urosonography as an alternative to fluoroscopy during video urodynamics (United States)

- "Contrast-enhanced voiding urosonography (**CeVUS**) has been approved in the evaluation of vesicoureteral reflux and **has been shown to have equal or superior diagnostic value to VCUG**."

Contrast-enhanced voiding urosonography (CEVUS) as a safe alternate means of assessing vesicoureteral reflux in pediatric kidney transplant patients (United States)

- "Although voiding cystourethrogram (VCUG) is currently the gold standard in VUR evaluation, there is ionizing radiation exposure. Contrast-enhanced voiding urosonography (CEVUS) uses ultrasound contrast agents to visualize the urinary tract and has been reported to be safe and effective in VUR evaluation in children."
- "ceVUS can provide an alternate means of safely evaluating VUR in kidney transplant patients with similar outcomes, potentially lower costs, and no exposure to ionizing radiation."

Imaging for Vesicoureteral Reflux: Counterpoint-cost, diagnostic performance, and preferences need to be further assessed before replacing VCUG with ceVUS (United States)

- I can't access this article but it is a "counterpoint" aka, pro-VCUG argument. I would like to read this, I am reaching out to the writers.

Parental perception of contrast enhanced voiding ultrasonography urodynamics vs fluoroscopic urodynamics

- "In this study, we aimed to understand how parents perceived their child's experience of undergoing ceVUS during UDS compared to fluoroscopic (fluoro) UDS."

- "**All 53 parents (100%) were satisfied/very satisfied with their ceVUS experience**; 48 parents (90.6%) preferred ceVUS, 3 parents (5.7%) preferred fluoro UDS, and 2 (3.8%) were neutral. On average, **parents perceived ceVUS to be more comfortable (72.7%) and produce better results** (67.4%) than fluoro UDS. The majority felt that both studies allowed the same contact with their child (52.3%) and took the same amount of time (50.0%). However **29.5% felt ceVUS was faster and 34.1% felt ceVUS allowed more contact with their child** (Fig. 1). 26 parents (49.1%) specifically noted no radiation as the reason why they preferred ceVUS over fluoro."

- "The majority of parents preferred ceVUS over fluoro UDS. ceVUS was perceived to be more comfortable and provide better results. Many parents highlighted no radiation and no fluoroscopic machinery as factors in preference of ceVUS over fluoro. The parents who preferred ceVUS UDS had children who had both studies done at an earlier age compared to the parents who preferred fluoro UDS."

The Utility of Noninvasive Urinary Biomarkers for the Evaluation of Vesicoureteral Reflux in Children (December 2023)

- "Our results encourage further studies to evaluate LL-37, IL-6, and NGAL as **noninvasive urinary markers that can improve the management of patients with VUR**. Moreover, these urinary biomarkers may become ***alternative assessment tools to VCUG*** and DMSA scans. According to our study, urinary NGAL and LL-37 can be **useful in differentiating severe from mild VUR**. Thus, it could be easier to identify patients who require antibiotic prophylaxis or surgical intervention."
- "All these aspects would ***increase patient comfort and reduce the costs*** related to hospitalizations and investigations. Also, due to the prognostic value of these markers in diagnosing RS and RN, it may be easier to identify patients at risk of

developing CKD, allowing prompt therapeutic intervention that would improve clinical outcomes."

- "For the diagnosis of VUR, we used the **medical records** and voiding cystourethrogram (VCUG). The VCUG is the ***gold standard*** investigation for the diagnosis of VUR and consists of bladder catheterization with the inoculation of a contrast agent, followed by a radiological examination. **The VCUG allows the diagnosis of VUR, staging, and description of the anatomy of the urinary tract**, and is also indicated for ***tracking the evolution of VUR***."
- "Urinary IL-6, NGAL, and LL-37 could serve as ***valuable markers for diagnosing and predicting outcomes in patients*** with VUR and RN. These biomarkers could help to **identify the severity of kidney injury in children with VUR**. Based on our results and similar ones previously published, future prospective studies will be able to establish the role of these markers in the **early detection of patients at risk** for unfavorable evolution."
- "Moreover, ***these noninvasive and easy-to-determine urinary markers*** can facilitate the monitoring of evolution, **replacing invasive and laborious examinations, such as the VCUG**. Besides the diagnostic and prognostic potential, the markers studied by us can ***influence the clinical management of patients with VUR***. They could be used to **distinguish patients who require surgical intervention from those who can be managed with prophylactic antibiotic therapy** or those who can be only followed up clinically.

Urologic practice patterns of pediatricians: a survey from a large multisite pediatric care center (December 2023)

- "An anonymous 15-question survey was created and distributed to all pediatricians at our institution, a large multisite care center. This study was deemed exempt by the institutional review board."

- "55 of the 122 (45%) providers queried responded. **93% of the participants were female**, and 7.3% were male. 55% recommended testicular self-examination at adolescence, while 39% did not recommend at any age. 78% stated that they were "Fairly confident" in the exam for undescended testicle (UTD). One-third referred patients with UDT to a subspecialist upon recognition at birth, 13% at 3 months of age, and 28% at 6 months of age. **10% reported obtaining a VCUG after the first febrile urinary tract infection (UTI), 26% after the second, and 36% only if there were abnormal findings on renal ultrasound**. **28% of providers reported that they refer to pediatric urology after the initial febrile UTI**. **19% provided antibiotics for UTI symptoms alone with negative urinalysis and urine culture**."
- "**Despite established guidelines, *practice patterns varied* among pediatricians.** Pediatricians typically followed the AAP's guidelines regarding VCUGs (**62%**), with ***only a few adhering to urologic recommendations* (9%)**. Despite the consistency between AAP and AUA guidelines regarding the age at which to refer a patient for cryptorchidism, **about 70% of practitioners referred patients too early or too late**."
- "Harmonized, **consolidated guidelines between pediatricians and pediatric urologists would improve patient care and efficiency** of the healthcare system."
- "After initial febrile UTI, **10% of respondents reported ordering a VCUG** while **28% report that they would directly refer to pediatric urology** for all further work up. The largest group of providers (36%) ordered a VCUG ***only if there were abnormal findings on renal ultrasound***. **26.4% preferred to order a VCUG after a second febrile UTI.**
- "75% of pediatricians adhered to AUA standards regarding the performance of GU exam. **40% of pediatricians adhered to AUA standards regarding performance of female GU exam**. 28% of pediatricians adhered to AUA guidelines regarding the timing of referral for UDT. **62% of pediatricians adhered to the AAP guidelines regarding VCUG timing**. 81% of pediatricians adhered to AAP guidelines regarding treating UTIs with a negative urine culture."

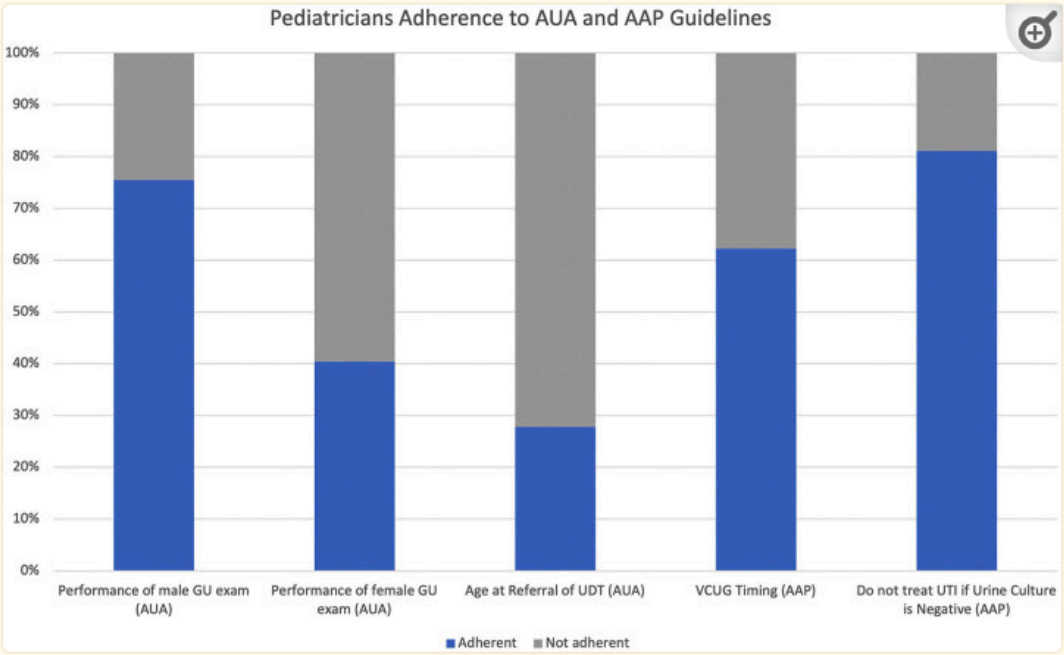


Figure 1

Pediatricians' adherence to AUA and AAP guidelines. This figure represents the percentage of pediatricians who adhere to AUA and AAP guidelines. 75% of pediatricians adhered to AUA standards regarding the performance of GU exam. 40% of pediatricians adhered to AUA standards regarding performance of female GU exam. 28% of pediatricians adhered to AUA guidelines regarding the timing of referral for UDT. 62% of pediatricians adhered to the AAP guidelines regarding VCUG timing. 81% of pediatricians adhered to AAP guidelines regarding treating UTIs with a negative urine culture.

- "***The timing of obtaining a VCUG has historically been controversial*** and our study suggests that this continues to be **an area of ongoing debate**. **62% of pediatricians** (36% obtained if abnormality seen in ultrasound and 26% obtained after second febrile UTI) followed the most recent guidelines put forth by the AAP, which ***recommends against a routine VCUG after the first febrile UTI*** unless abnormalities are present on the renal bladder ultrasound or there are other clinical reasons to suspect high-grade vesicoureteral reflux or obstructive uropathy."
- "Although the majority of pediatricians are following AAP guidelines in terms of timing of obtaining a VCUG, there is growing evidence that renal scarring may be missed by not obtaining VCUGs after the first UTI: Narchi et al. showed that following

AAP guidelines would have missed 56% of children with VUR ≥ grade II, and all children with renal scarring would not have been imaged."

- "While VCUGs are an ***invasive imaging modality*** and can cause morbidity such as ***patient and parent distress***, although perhaps less with pretest preparation and child life specialist involvement (22), future studies will be necessary to delineate risk factors for developing renal scarring in order to not improperly delay the diagnosis of **symptomatic vesicoureteral reflux**."
- "A small number (9%) of pediatricians did prefer to order a VCUG after the first febrile UTI, which is ***supported by the Section of Urology***."

Q4. General: How often do you perform a comprehensive genitourinary (GU) examination for female patients (well-child)?

ANSWER CHOICES	RESPONSES	
GU examination is never performed at a well-child visit unless the patient or guardian(s) report a concern	2	3.8%
GU examination is performed at every well child visit, but stopped at adolescence	21	40.4%
GU exam is always performed at all ages and every well-child visit	21	51.9%
GU examination is only performed at initial visit and if normal, forego future examinations	2	3.8%
If patient sees urology, I do not continue to perform GU examinations	0	0%
Total	52	

Q5. General: How often do you perform a comprehensive genitourinary (GU) examination for male patients (well-child)?

ANSWER CHOICES	RESPONSES	
GU examination is never performed at a well-child visit unless the patient or guardian(s) report a concern	1	1.9%
GU examination is performed at every well child visit, but stopped at adolescence	9	17.0%
GU exam is always performed at all ages and every well-child visit	40	75.5%
GU examination is only performed at initial visit and if normal, forego future examinations	3	5.7%
If patient sees urology, I do not continue to perform GU examinations	0	0%
Total	53	

Q9. UTI: At what time point do you order a VCUG following a febrile UTI?

ANSWER CHOICES	RESPONSES	
After the first febrile UTI	5	9.4%
After the second febrile UTI	14	26.4%
Only if there are abnormal findings on renal ultrasound	19	35.8%
After the first febrile UTI, referral to pediatric urology for evaluation and initiation of workup	15	28.3%
Total	53	

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***Neutrophil-to-lymphocyte ratio as a predictor of primary vesicoureteral reflux evolution in children with associated acute pyelonephritis* (November 2023)**

- "Primary vesicoureteral reflux (VUR) is a congenital disorder, typically resulting from a short submucosal tract at the junction between ureter and bladder, ***not*** associated with other obstructive, neurological or vascular abnormalities (1). It is one of the **most common urological diseases in childhood**, with ***an estimated prevalence of 0.4–1.8% in the general pediatric population*** and ***up to 30% in children with a history of urinary tract infection (UTI)*** (2,3). In these patients, VUR plays an important role in the pathogenesis of UTIs as the relationship between acute

pyelonephritis (APN), VUR and renal damage is well established…This potential morbidity makes early diagnosis essential, as well as the determination of the clinical course of VUR, **due to the high percentage of spontaneous resolution** (SR) observed during its evolution."

- "Imaging studies performed included urinary ultrasound, Tc-99m-dimercaptosuccinic acid (DMSA) renal scan scintigraphy, voiding cystourethrography (VCUG). After APN diagnosis, urinary ultrasound and DMSA were performed during the first 5 days of admission. Subsequently, **VCUG was performed 4 weeks after APN resolution**, in order to evaluate the presence of VUR as well as the degree and laterality. Follow-up was performed by reviews in the outpatient clinic every 3 months, **with repeat VCUG to monitor the VUR clinical course at 6-monthly intervals**."
- "NLR may be considered as **a simple and cost-effective predictor of clinical outcome of VUR,** which correlates with the increased risk of developing complications of primary VUR after an episode of APN during follow-up. Therefore, it should be included in the management algorithm for these patients, although future prospective studies are still required to confirm these results."

****

2024

Risk factors for new renal scarring in children with vesicoureteral reflux receiving continuous antibiotic prophylaxis (Jan 2024)

- "This study aimed to analyze the clinical data of children receiving CAP treatment for VUR in our hospital from 2016 to 2019, with the purpose of summarizing the risk factors for new kidney scarring in children with VUR."

- "Previous studies have found that in children with VUR who use CAP intervention, high-level VUR, especially IV-V grade VUR, is an independent risk factor for NRS26. Mattoo et al.5 found in a prospective randomized controlled clinical study (RIVUR) that children with IV-V grade VUR were more likely to develop BT-UTI and renal scars, 24.2 and 1.88 times higher than those with I–III grade VUR, respectively. Sitarah Mathias et al.27 also found that patients with high-grade VUR patients were more likely than those with low-grade VUR patients to have renal scarring."

Therapeutic Management of Children with Vesicoureteral Reflux **(January 2024)**

- "…VUR represents a risk factor for UTI development, distinguishing two different entities related to it, "reflux disease" and "reflux symptom"; the first involves predominantly ***males, with a rare incidence, prenatally or under two years of age***, with severe VUR (stage IV–V), abnormal renal parenchyma and urinary tract, and **spontaneous resolution in 50% of cases**. ***The second and more common form of VUR is usually assessed in females***, with low-grade I–III VUR, associated with normal kidneys and urinary tract, **with a high rate of resolution (80–90%)**.

- **A voiding cystourethrogram (VCUG) is the "gold standard" for VUR detection**, allowing grading of the severity from a wisp of contrast just beyond the bladder with no dilatation of the ureter or collecting system (grade I) up to dilatation and tortuosity of the ureters with calyceal clubbing (grade V). ***This radiologic test is an invasive procedure requiring urethral catheterization, often painful and traumatic for the child, causing UTIs in 1 to 3% of cases***. Although a diagnostic study can be achieved with a relatively low radiation dose by using careful technique and modern equipment, in practice, **the range of doses is extremely wide**.

- "Other tests have been proposed to detect reflux, such as **contrast-enhanced voiding urosonography (ceVUS)**, an ionizing radiation-free technique using ultrasound with a contrast agent instilled into the bladder to image the urinary tract. ***Several studies revealed ceVUS as a valid alternative method for VUR***

assessment, with comparable results in terms of sensitivity and specificity with a VCUG in detecting and grading VUR."

- "However, although ceVUS has several advantages, **its limitations should be underlined**, highlighting **the lack of uniform standardization of the method**, and some issues regarding ultrasound, such as bowel gas interference. The biggest limitation of ceVUS is the ***incapability to visualize the urethra*** and, in consequence, its low diagnostic ability to ***rule out congenital urethral pathologies***, such as urethral valves. In this case, **a VCUG is reserved for the correct diagnosis**."

- "Behind radiological procedures, **several urinary biomarkers are being studied to achieve early diagnosis**, facilitating staging and therapeutic VUR management. In particular, some interleukins or neutrophil gelatinase-associated lipocalin have been associated with the innate immune reaction and proinflammatory state ***characterizing children with VUR***, with potential clinical application to **easily identify patients** who require antibiotic prophylaxis or surgical intervention."

- "However, **prospective and larger studies are needed to confirm the role of these or other biomarkers as alternative, non-invasive tools to VCUG and ceVUS**."

- "***The choices of the patients and the radiological test to perform are not unique challenges***, considering that **the therapeutic approach of VUR is a matter of debate**."

- There are ***two distinct directions in the literature*** regarding the investigation of **an uncomplicated first febrile UTI in a child**. In general, when presented with a first febrile UTI in a child, **physicians recommend fewer investigations and less treatment**, ***in contrast to*** **surgeons who advocate extensive investigation and aggressive intervention if imaging detects an abnormality** [19].

- Moreover, the child affected by VUR undergoes renal scintigraphy to complete the diagnostic process, evaluating the function of the kidneys. ***The risk of a child without other congenital abnormalities of the kidney and urinary tract***

developing chronic kidney disease as a result of repeated febrile UTIs associated with VUR is very low [20].

- **Spontaneous resolution of VUR can be observed in about more than 80% of grades I and II, around 45% of grade III, and less than 10% of grades IV and V** [21]. According to the main international guidelines, VUR therapy is based on three strategies, depending on the severity of VUR ***and physicians' preferences*** [22].

- In children without UTI symptoms and with low grades of VUR, **the "wait and watch" approach could be considered due to the *high probability of spontaneous resolution*** [23].

- If it is known that **VUR could resolve spontaneously over time**, waiting for this to occur rather than treating it should only happen in the **absence of repeated febrile UTIs**, ***a risk factor for renal scarring*** [24].

- However, regular follow-up visits are required to enable adequate monitoring of the patient's status, and this approach is recommended for patients with a relatively low risk of renal injury, such as males with low-grade VUR.

- Conversely, independently from the severity of the VUR, in children with LUTS and recurrent UTIs, continuous antibiotic prophylaxis (CAP) could be prescribed [26].

- Whether **VUR contributes to the risk of chronic kidney disease** (CKD) **remained unclear**.

A Single-System Ectopic Ureter in a Child: A Challenge for Early Diagnosis (January 2024)

****Including for people like Abby H., and because I've found research suggesting VCUG as treatment for ectopic ureters. This isn't reflected here.****

- "An ectopic ureter is an uncommon anomaly, usually associated with a duplicated urinary system. Up to 20% of ectopic ureters occur in a single system. In females,

only 25% of ectopic ureters insert into the vagina and usually cause urinary incontinence, which can be confused with vaginal discharge. **The diagnostic investigation includes urinary tract ultrasound, DMSA, and urethrocystography**."

Development and multi-institutional validation of a deep learning model for grading of vesicoureteral reflux on voiding cystourethrogram: a retrospective multicenter study (Feb. 2024)

- Voiding cystourethrography (VCUG) is the **gold standard** for the diagnosis and grading of vesicoureteral reflux (VUR). **However, VUR grading from voiding cystourethrograms is highly subjective with low reliability.** This study aimed to develop a deep learning model to improve reliability for VUR grading on VCUG and compare its performance to that of clinicians.

Stratifying Antenatal Hydronephrosis: Predicting High-Grade VUR Using Ultrasound and Scintigraphy (Feb 2024)

- Antenatal hydronephrosis (AHN), detected in approximately one percent of prenatal ultrasounds, is caused by vesicoureteral reflux (VUR) in 15–21% of cases, a condition with **significant risks** such as urinary tract infections and renal scarring. Our study addresses the diagnostic challenges of VUR in AHN. Utilizing renal ultrasonography and scintigraphy, we developed a novel scoring system that accurately predicts high-grade VUR, optimizing diagnostic precision while ***minimizing the need for more invasive methods like voiding cystourethrogram (VCUG)***;

- (2) Methods: This retrospective study ***re-analyzed renal ultrasonography, scintigraphy, and VCUG images*** from infants admitted between 2003 and 2013, excluding cases with complex urinary anomalies;

- (3) Results: Our analysis included 124 patients (75% male), of whom 11% had high-grade VUR. The multivariate analysis identified visible ureter, reduced renal length, and decreased differential renal function (DRF) as primary predictors. Consequently, we established a three-tier risk score, classifying patients into low,

intermediate, and high-risk groups for high-grade VUR, with corresponding prevalences of 2.3%, 22.2%, and 75.0%. The scoring system demonstrated 86% sensitivity and 79% specificity;

- (4) Conclusions: Our scoring system, focusing on objective parameters of the visible ureter, renal length, and DRF, effectively identifies high-grade VUR in AHN patients. This method enhances diagnostics in ANH by **reducing reliance on VCUG and facilitating more tailored and less invasive patient care**.

Comparison of contrast-enhanced voiding urosonography using second-generation contrast agents and voiding cystourethrogram (April, 2024)

- "Voiding cystourethrogram (VCUG) has been considered the gold standard for detecting and evaluating vesicoureteral reflux (VUR) among children. However, **ionizing radiation exposure is a concern** for this diagnostic modality."
- "**ceVUS is radiation-free, effective, and safe method for identifying and grading VUR**."
- "In our small sample of 18 patients, **the detection of vesicoureteral reflux by ceVUS was comparable to that of VCUG**."
- "ceVUS shows excellent diagnostic sensitivity of up to 100& in detecting VUR, similar to VCUG."
- "The European Association of Urology continues to regard the VCUG as the gold standard in the diagnosis of VUR."
- "[in regard to patients from sample] Two patients consented but were excluded from the study; one could not be catheterized, and the other was excluded due to inadvertent catheterization of a ureterocele and refusal for re-catheterization. Before being enrolled in the study **details of the procedure and the potential risks were explained to the parents and patients who were older than 8 years of age.** Informed consent was obtained from the parent and assent was obtained from the patients who were 8 years and older."

- "No immediate adverse events were noted in our study. No significant adverse events were observed in the 18-h follow-up interview. Two patients had transient low-grade fever, one had mild abdominal pain, and **one was irritable after the procedure.**"
- "CeVUS has been performed in Europe for the last two decades. Lumason/Sonovue got FDA approval for intravesical use in December 2016."

[(Uro)genital Developmental Disorders] (Germany) (May, 2024)

- "The primary procedure for imaging the genitals is sonography, which must be performed with appropriate empathy."
- "Dedicated magnetic resonance imaging (MRI) is indicated as advanced imaging in interdisciplinary consultations. **Invasive procedures**, such as genitography combined with **micturition cystourethrography (MCU) using X-rays or contrast-enhanced sonography**, are rarely required."

Imaging of Vesicoureteral Reflux: AJR Expert Panel Narrative Review (June, 2024)

- "Considerations include indications for VUR imaging, patient preparation, conduct of the examination, issues related to radiologic reporting, and cost-effectiveness. **An emphasis is placed on ceVUS**, which is the most recently introduced of the three imaging modalities and is **receiving growing support among pediatric radiologists**."
- "When compared with VCUG as a reference standard, many authors have concluded that ceVUS has a diagnostic accuracy that exceeds 90% [33, 49–51]. Moreover, some investigators have observed a greater ability to diagnose grade 2–5 reflux by ceVUS than by VCUG [30, 31, 39]."
- "**Experts** now generally consider **ceVUS to have similar (if not slightly higher) diagnostic performance to VCUG**, and ceVUS has received endorsement by the

European Society of Paediatric Radiology when performed with adherence to appropriate technique [53, 54].”