Effective and Organ Specific Doses from Videourodynamics in Children

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Background

- Prior studies on radiation dose from videourodynamics reported displayed air karma (AK) limited in assessing the magnitude of exposure and risk to internal organs
- Air karma is an estimate of what the C arm detects is the radiation dose in the atmosphere

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Radiation

Deterministic Effect

A threshold dose causes harm

Stochastic Effect

Accumulated doses over time increase risk of malignancy

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Purpose and Method

The purpose of study was to determine levels of radiation exposure from video urodynamics by calculating:

1. Air Karma= mGy
2. Entrance skin dose = mGy
3. Organ (testes/ovary) dose= Sv
4. Effective dose = Sv

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What effective doses are known -ADULT Doses

Examination	Average Effective Dose (mSv)	Range reported in Literature (mSv)
2 view CXR	0.1	0.05-0.24
Abdomen	0.7	0.04-1.1
IVP	3	0.7-3.7
CT abdomen	8	3.5-25
CT pelvis	6	3.3-10
MAG3	2.6	
DMSA	3.3	
PEDIATRIC VCUG	newborn male=0.11-0.47mSv newborn female=0.12-0.42mSv 10yo male =0.28-0.93mSv 10yo female=0.55-0.82mSv	

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Seattle Children's results

Characteristic (n=100)	mean ± SD (range)	p value
Age, years	9.3 ± 5.7 (0.2-20.8)	<0.01
Male	45	0.54
Height, cm	124.4 ± 33.2 (55.6-181.9)	<0.01
Weight, kg	34.9 ± 23.0 (3.0-97.1)	<0.01
BMI, kg/m2	19.5 ± 5.4 (7.0-35.4)	<0.01
Primary diagnosis		0.38
Anatomic	14	
Neurogenic bladder	73	
Functional disorder	13	
Number of fills	1.5 ± 0.7 (1-4)	0.27
Bladder capacity, mL	262 ± 264 (13-200)	0.02
Fluoroscopy time, min	0.17 ± 0.12 (0.04-0.70)	<0.01
Air kerma, mGy	1.38 ± 1.26 (0.13-6.71)	
Entrance skin dose, mGy	2.18 ± 2.00 (0.21-10.61)	
Testis-specific dose, mGy	0.09 ± 0.10 (0.01-0.46)	
Ovary-specific dose, mGy	0.20 ± 0.13 (0.01-0.27)	
Effective dose, mSv	0.07 ± 0.05 (0.004-0.23)	

PEDIATRIC VCUG

newborn male= 0.11-0.47mSv

newborn female= 0.12-0.42mSv

10yo male = 0.28-0.93mSv

10yo female= 0.55-0.82mSv

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Conclusions

- Mean effective dose from videourodynamics at our institution was less than a pediatric VCUG.
- Acceptable organ specific dose and effective dose can be achieved but remain significant

Risk Benefit

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Limitations

- Finding are unique to Seattle Children's.
- Hawthorne effect - change in behavior once aware one is being studied.
- The role of vesicoureteral reflux
- Fluoro time was measured in minutes, not seconds.

Clinical Factors for Discussion

- Urodynamics Nurse- key role in minimizing radiation exposure in this pediatric population
- Awareness of equipment and patient positioning influence dose of radiation
- Develop patient and parent education material regarding use of fluoroscopy during urodynamics

ALARA

As Low as Reasonably Achievable

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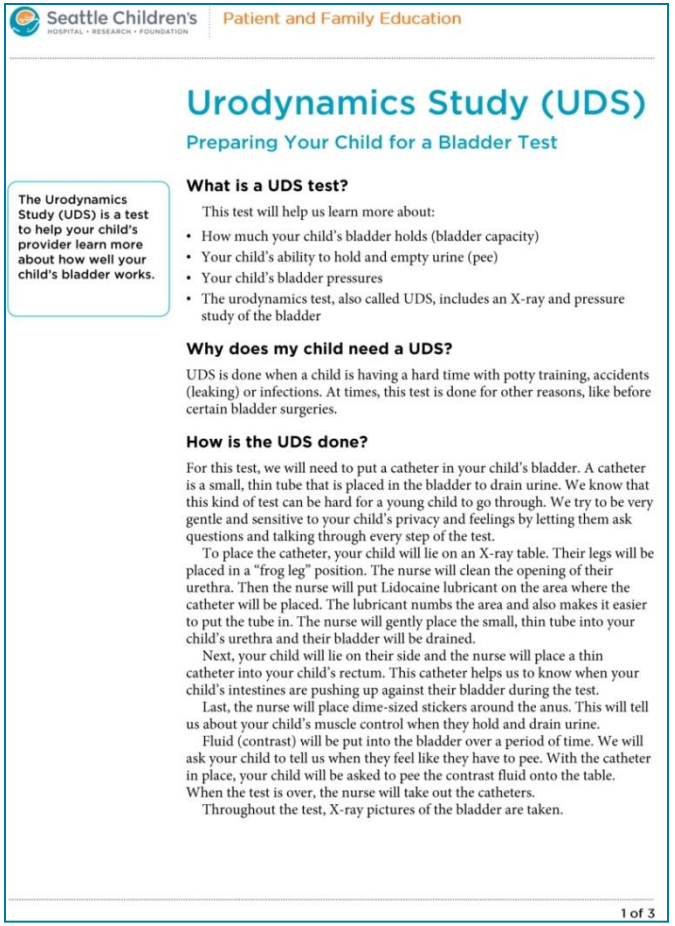
Patient Preparation

- Assess family for readiness of exam 1-2 weeks prior – education of family.
- Determine need for child life therapy - keep child calm, distraction.



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Urodynamics Study (UDS)

Preparing Your Child for a Bladder Test

The Urodynamics Study (UDS) is a test to help your child's provider learn more about how well your child's bladder works.

What is a UDS test?

This test will help us learn more about:

- How much your child's bladder holds (bladder capacity)
- Your child's ability to hold and empty urine (pee)
- Your child's bladder pressures
- The urodynamics test, also called UDS, includes an X-ray and pressure study of the bladder

Why does my child need a UDS?

UDS is done when a child is having a hard time with potty training, accidents (leaking) or infections. At times, this test is done for other reasons, like before certain bladder surgeries.

How is the UDS done?

For this test, we will need to put a catheter in your child's bladder. A catheter is a small, thin tube that is placed in the bladder to drain urine. We know that this kind of test can be hard for a young child to go through. We try to be very gentle and sensitive to your child's privacy and feelings by letting them ask questions and talking through every step of the test.

To place the catheter, your child will lie on an X-ray table. Their legs will be placed in a "frog leg" position. The nurse will clean the opening of their urethra. Then the nurse will put Lidocaine lubricant on the area where the catheter will be placed. The lubricant numbs the area and also makes it easier to put the tube in. The nurse will gently place the small, thin tube into your child's urethra and their bladder will be drained.

Next, your child will lie on their side and the nurse will place a thin catheter into your child's rectum. This catheter helps us to know when your child's intestines are pushing up against their bladder during the test.

Last, the nurse will place dime-sized stickers around the anus. This will tell us about your child's muscle control when they hold and drain urine.

Fluid (contrast) will be put into the bladder over a period of time. We will ask your child to tell us when they feel like they have to pee. With the catheter in place, your child will be asked to pee the contrast fluid onto the table. When the test is over, the nurse will take out the catheters.

Throughout the test, X-ray pictures of the bladder are taken.

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C-Arm and Room Setup

- Lead shielding and thyroid shields for personnel in room
- X-ray tube below the table if possible
- Patient is positioned close to image receptor and far from X-ray tube
- Pulsed or low dose mode if image quality is acceptable
- Avoid magnification

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Procedure

Procedure

- Beam-on time and interval of imaging commensurate with need for information
- Obtain voiding and post-void images
- Consider additional fill cycles if study inadequate

Post Procedure

- Regular maintenance and inspection of C-arm equipment
- Documentation of fluoro time , air karma, dose area product

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Questions?

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