Contrast Enhanced Voiding Urosonography (ceVUS):
How we do it

Susan J. Back, MD

Department of Radiology, The Children’s Hospital of Philadelphia
No Disclosures
ceVUS

What it is
What to do
What *not* to do
What it looks like
What is ceVUS?

Similar to VCUG

Use ultrasound & ultrasound contrast agents
What is ultrasound contrast?
What is ultrasound contrast?

Encapsulated gas filled MICROBUBBLES
US contrast ≠ CT contrast
US contrast ≠ MRI contrast

IV Metabolism
Gas: exhaled through lungs within 10 min
Shell: metabolized in the liver

Not nephrotoxic
Ultrasound Contrast

- **Lumason®** [Bracco, Italy]
  - **Gas:** sulphur hexafluoride
  - **Shell:** phospholipid
  - **[SonoVue®]**

  - Bubble size: 1.3-2.5 um
  - Concentration: 1.5-5.6 x 10^8 /mL
  - Dose 0.5-1% bladder filling volume

- **Optison®** [GE Healthcare, USA]
  - **Gas:** perflutren
  - **Shell:** albumin

  - Bubble size: 3-4.5 um
  - Concentration: 5-8 x 10^8 /mL
  - Dose 0.1-0.5% bladder filling volume

RBC 6-8 um
Ultrasound Contrast

- **Lumason®** [Bracco, Italy]
  - *FDA approved*
  - IV CEUS Liver pediatrics 4/2016
  - Only agent pediatric approval

- **Optison®** [GE Healthcare, USA]
  - *FDA approved*
  - Adult echo
How is it done?

- Bladder catheterization
  - Sterile technique
  - Empty bladder
- Contrast administration
  - Infusion
  - Injection
- Dedicated US settings
Contrast administration

1. Place the contrast bag.
2. Connect the contrast bag to the tubing.
3. Secure the tubing with tape.
4. Connect to bladder catheter.
Contrast administration

**Infusion:** 0.2% solution

**Injection:** 0.1 mL contrast
50 mL saline
Contrast US Modality

Low mechanical index [MI]

Other technical features:
- Color overlay
- Background subtraction
- Dual presentation
- Optimized for specific contrast
Kidneys

Supine, prone or both

Sitting, standing

Alternating scan right/left

Dual modality useful
Pitfall: Dual Modality

Decreased gray scale resolution
Pitfall: Background Subtraction

- Excessive
- Incomplete
Bladder

Monitor bladder filling

Injection small bolus of NaCl

Optimal bladder filling:

*Homogenous distribution*

*No acoustic shadowing*

*Visualization of bladder base*

*Visualization of retrovesicular space*
Pitfall: Inadequate bladder contrast distribution

**Normal saline container:** Glass

- Injection angle 90° and ↑speed
- Normal saline flush missing
- Low or high US contrast agent dose
- US scan parameters incorrect [↑MI]
- US contrast vial usage duration
- Preceding study with intravenous x-ray, CT or MR contrast agent
Pitfall: Inadequate bladder contrast distribution

Normal saline container: Glass
Injection angle 90° and ↑speed
Normal saline flush missing
Low or high US contrast agent dose
US scan parameters incorrect [↑MI]
US contrast vial usage duration
Preceding study with intravenous x-ray, CT or MR contrast agent
Pitfall: Inadequate bladder contrast distribution

Normal saline container: Glass
Injection angle 90° and ↑speed
Normal saline flush missing
Low or high US contrast agent dose
US scan parameters incorrect [↑MI]
US contrast vial usage duration
Preceding study with intravenous x-ray, CT or MR contrast agent
Pitfall: Inadequate bladder contrast distribution

Normal saline container: Glass
Injection angle 90° and ↑speed
Normal saline flush missing
Low or high US contrast agent dose
US scan parameters incorrect [↑MI]
US contrast vial usage duration
Preceding study with intravenous x-ray, CT or MR contrast agent
Pitfall: Inadequate bladder contrast distribution

Normal saline container: Glass
Injection angle 90° and ↑speed
Normal saline flush missing
Low or high US contrast agent dose
US scan parameters incorrect [↑MI]
US contrast vial usage duration
Preceding study with intravenous x-ray, CT or MR contrast agent
Pitfall: Inadequate bladder contrast distribution

Normal saline container: Glass
Injection angle 90° and ↑ speed
Normal saline flush missing
Low or high US contrast agent dose
US scan parameters incorrect [↑MI]
US contrast vial usage duration
Preceding study with intravenous x-ray, CT or MR contrast agent
Pitfall: Inadequate bladder contrast distribution

Normal saline container: Glass
Injection angle 90° and ↑speed
Normal saline flush missing
Low or high US contrast agent dose
US scan parameters incorrect [↑MI]
US contrast vial usage duration

Preceding study with intravenous x-ray, CT or MR contrast agent
### Safety: Ultrasound Contrast

#### Symptoms related to catheterization

<table>
<thead>
<tr>
<th>Patients</th>
<th>VCUG (n = 100)</th>
<th>RNC (n = 100)</th>
<th>DRS (n = 28)</th>
<th>Total (n = 228)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys and girls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>32 (32.0)</td>
<td>37 (37.0)</td>
<td>11 (39)</td>
<td>80 (35.1)</td>
</tr>
<tr>
<td>No symptoms</td>
<td>68 (68.0)</td>
<td>63 (63.0)</td>
<td>17 (61)</td>
<td>148 (64.9)</td>
</tr>
</tbody>
</table>

### Type and Duration of Symptoms Reported in 228 Children after VCUG, RNC, and DRS

<table>
<thead>
<tr>
<th>Symptom or Duration</th>
<th>VCUG (n = 100)</th>
<th>RNC (n = 100)</th>
<th>DRS (n = 28)</th>
<th>Total (n = 228)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dysuria</td>
<td>29 (29.0)</td>
<td>35 (35.0)</td>
<td>11 (39)</td>
<td>75 (32.9)</td>
</tr>
<tr>
<td>Wetting</td>
<td>1 (1.0)</td>
<td>5 (5.0)</td>
<td>1 (4)</td>
<td>7 (3.1)</td>
</tr>
<tr>
<td>Gross hematuria</td>
<td>5 (5.0)</td>
<td>3 (3.0)</td>
<td>1 (4)</td>
<td>9 (3.9)</td>
</tr>
<tr>
<td>Fever*</td>
<td>2 (2.0)</td>
<td>1 (1.0)</td>
<td>0</td>
<td>3 (1.3)</td>
</tr>
<tr>
<td>Total</td>
<td>32 (32.0)</td>
<td>37 (37.0)</td>
<td>11 (39)</td>
<td>80 (35.1)</td>
</tr>
</tbody>
</table>
### Safety: Ultrasound Contrast

<table>
<thead>
<tr>
<th>Studies</th>
<th>n</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levovist®</td>
<td>1062</td>
<td>17</td>
<td>1.6</td>
</tr>
<tr>
<td>SonoVue®</td>
<td>1889</td>
<td>37</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2951</td>
<td>54</td>
<td>1.8</td>
</tr>
<tr>
<td>European Survey</td>
<td>4131</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td>7082</td>
<td>54</td>
<td>0.8</td>
</tr>
</tbody>
</table>

### Adverse events

- **26** Dysuria
- **15** Transient macrohematuria
- **3** Abdominal discomfort/pain
- **2** Anxiety/crying
- **2** Urinary retention
- **1** Frequency
- **1** Blood/mucous discharge
- **1** Perineal irritation
- **1** Urethral pain
- **1** Urinary tract infection
- **1** Vomiting
Safety: Ultrasound Contrast

- Prospective study
- Primary objective safety evaluation
- ONLY ceVUS with SonoVue®
- Comprehensive evaluation
- Follow-up after a week

- NO serious adverse events
- 37 (3.7%) patients minor events
- Self-limited adverse events
- Catheterization likely cause
- High safety profile!
ceVUS Reflux Grading
ceVUS Urethral Imaging

Transperineal

Suprapubic

9 yo girl

1 mo boy

1 mo boy
4 month old girl, fever

Urine culture + E. coli

Imaging
  Renal bladder US
  VCUG
4 month old girl, fever

Urine culture + E. coli

Imaging

Renal bladder US
VCUG
4 month old girl, fever

Urine culture + E. coli

Imaging
  Renal bladder US
  Duplex left kidney
  VCUG
  Left grade 3 reflux

Antibiotic prophylaxis
18 months old follow up US

Imaging

Renal bladder US

Duplex left kidney

Urinary tract dilation

Left sag

Left trv
24 months old follow up ceVUS

Imaging

ceVUS

Bladder
24 months old follow up ceVUS Imaging ceVUS

Right kidney

Left kidney
Left kidney supine
Left kidney prone
VCUG at 4 months old

ceVUS at 24 months old
24 month old girl

Imaging
Renal bladder US
Duplex left kidney
VCUG/ceVUS
Left grade 3 reflux
Antibiotic prophylaxis

Follow up with ceVUS
Summary

What ceVUS is

How to do it

Pitfalls

Case example