Prenatal Urinary Tract Dilation: What to tell the pediatricians?

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Goals and Objectives

- Review a new consensus classification for prenatal and postnatal urinary tract dilation (UTD) by US that could be used by different specialties

- Distribute UTD classification among radiologists
• 1993 Society for Fetal Urology (SFU) described a classification to improve postnatal care of pt with ANH and PNH **BASED ON POSTNATAL US**

• Recommendations based on both antenatal and postnatal US findings
<table>
<thead>
<tr>
<th>SFU Grade</th>
<th>Pattern of renal sinus splitting</th>
<th>IVP Appearance</th>
<th>Ultrasound Variants</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFU Grade 0</td>
<td>No splitting</td>
<td><img src="image1.png" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td>SFU Grade 1</td>
<td>Urine in pelvis barely splits sinus</td>
<td><img src="image2.png" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td>SFU Grade 2</td>
<td>Urine fills intrarenal pelvis</td>
<td><img src="image3.png" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td>SFU Grade 2</td>
<td>Urine fills extrarenal pelvis major calyces Dilated</td>
<td><img src="image4.png" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td>SFU Grade 3</td>
<td>SFU Gr 2 and minor calyces uniformly dilated and parenchyma preserved</td>
<td><img src="image5.png" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td>SFU Grade 4</td>
<td>SFU Gr 3 and parenchyma thin</td>
<td><img src="image6.png" alt="Image" /></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3: The Society for Fetal Urology Hydronephrosis Grading System (http://www.uab.edu/images/peduro/SFU/sfu_grading_on_web/sfu_grading_on_web.htm).
Antenatal hydronephrosis

- Seen in 1-2% of pregnancies
- 40,000- 80,000 diagnosed annually

Table 2: Definition of ANH by APD.

<table>
<thead>
<tr>
<th>Degree of ANH</th>
<th>Second trimester</th>
<th>Third trimester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>4 to &lt;7 mm</td>
<td>7 to &lt;9 mm</td>
</tr>
<tr>
<td>Moderate</td>
<td>7 to ≤10 mm</td>
<td>9 to ≤15 mm</td>
</tr>
<tr>
<td>Severe</td>
<td>&gt;10 mm</td>
<td>&gt;15 mm</td>
</tr>
</tbody>
</table>

Multiple causes of antenatal hydronephrosis (ANH)

Table 5 The etiology of ANH.

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transient hydronephrosis</td>
<td>41–88%</td>
</tr>
<tr>
<td>UPJ obstruction</td>
<td>10–30%</td>
</tr>
<tr>
<td>VUR</td>
<td>10–20%</td>
</tr>
<tr>
<td>UVJ obstruction/megaureters</td>
<td>5–10%</td>
</tr>
<tr>
<td>Multicystic dysplastic kidney</td>
<td>4–6%</td>
</tr>
<tr>
<td>PUV/urethral atresia</td>
<td>1–2%</td>
</tr>
<tr>
<td>Ureterocele/ectopic ureter/duplex system</td>
<td>5–7%</td>
</tr>
<tr>
<td>Others: prune belly syndrome, cystic kidney</td>
<td>Uncommon</td>
</tr>
<tr>
<td>disease, congenital ureteric strictures and</td>
<td></td>
</tr>
<tr>
<td>megalourethra</td>
<td></td>
</tr>
</tbody>
</table>
Why is it helpful to find out about ANH?

- Detect and differentiate *clinically SIGNIFICANT* ANH before the onset of urologic complications (renal dysfunction/UTI/stones)
  - Detect *INSIGNIFICANT ANH* that doesn’t need further evaluation (transient)

- Transient/physiologic 50-70%

ANH Follow up

• UTI prophylaxis (antibiotic)
• Renal ultrasound (>2 days of life)
• Maybe VCUG
• Pediatric urologist consult
UTI/VCUG

• Role of UTI prophylaxis
  – Atypical, nonspecific presentation in infancy
  – Delay in diagnosis/treatment increased incidence of parenchymal scarring

• Role of VCUG: controversial
  – Risks
    – Not all VUR is clinically significant
    – High grade VUR: > UTI >risk of scarring

• Cost – approx. $90 million/year
SFU

• Paucity of evidence on which to base clinical management
• Mostly, only used by urologists
• A meta-analysis indicated that the SFU grading system is the most widely used with the best consistency (11/25 studies) BUT radiologists weren’t included in the survey

Confusing terminology

- Pelviectasis / pelvocaliectasis / caliectasis
- Mild / moderate / severe hydronephrosis
- Collecting system dilatation
- AP pelvis diameter
Multidisciplinary consensus on the classification of prenatal and postnatal urinary tract dilation (UTD classification system)

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– Standardize terminology
– Unified classification system (AP diameter, SFU grading system)
– Risk stratification
– Risk-based recommendations
Participants

- American College of Radiology (ACR)
- American Institute of Ultrasound in Medicine (AIUM)
- American Society of Pediatric Nephrology (ASPN)
- Society for Fetal Urology (SFU)
- Society for Maternal-Fetal Medicine (SMFM)
- Society for Pediatric Urology (SPU)
- Society for Pediatric Radiology (SPR)
- Society of Radiologists in Ultrasounds (SRU)
## UTD US parameters

<table>
<thead>
<tr>
<th>US parameters</th>
<th>Measurement/findings</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior-Posterior Renal Pelvic Diameter (APRPD)</td>
<td>(mm)</td>
<td>Measured on transverse image at the maximal diameter of intrarenal pelvis</td>
</tr>
<tr>
<td>Calyceal dilation</td>
<td>Central (major calyces) Yes/No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peripheral (minor calyces) Yes/No</td>
<td></td>
</tr>
<tr>
<td>Parenchymal thickness</td>
<td>Normal/Abnormal</td>
<td>Subjective assessment</td>
</tr>
<tr>
<td>Parenchymal appearance</td>
<td>Normal/Abnormal</td>
<td>Evaluate echogenicity, corticomedullary differentiation, and for cortical cysts</td>
</tr>
<tr>
<td>Ureter</td>
<td>Normal/Abnormal</td>
<td>Dilation of ureter is considered abnormal; however, transient visualization of the ureter is considered normal postnatally Evaluate wall thickness, for the presence of ureterocele, and for a dilated posterior urethra</td>
</tr>
<tr>
<td>Bladder</td>
<td>Normal/Abnormal</td>
<td></td>
</tr>
</tbody>
</table>

* Amniotic fluid in ANH
UTD classification

- Based on gestational age and whether the UTD is detected antenatally or postnatally
- Follow-up scheme based on the UTD classification
- Correlated with the risk of postnatal uropathies

AP Diameter

- Transverse view
- Fetal US: diameter of *intrarenal* pelvic dilation
  - AP plane of the *patient*
  - As opposed to the AP plane of the kidney
- Postnatal US: diameter at the *hilum*
  - Prone > supine
  - Consistency on serial imaging/reporting
Figure 1  Ultrasound appearance of normal fetal kidneys at 32 weeks gestation. A: Imaging in the transverse plane demonstrates an anterior-posterior renal pelvis diameter (APRPD) measuring < 7 mm, which is within the normal range for this gestational age. The measurement is taken with the spine at the 12 o’clock position and the calipers are placed at the widest part of the intrarenal fluid collection. B: Imaging in the sagittal plan demonstrates normal appearing parenchyma and no peripheral calyceal dilation. This fetus has a normal appearing bladder (not shown) and the ureters are not visualized.
Figure 2  Appearance of normal kidneys on postnatal ultrasound. A: Imaging in the transverse plane demonstrates an anterior-posterior renal pelvis diameter (APRPD) < 10 mm, which is normal for age. Note that the APRPD is measured at the maximal diameter of intrarenal pelvis dilation rather than that of extrarenal pelvis dilation. B: Imaging in the sagittal plane demonstrates normal renal parenchyma without any calyceal dilation. The bladder is normal (not shown), and the ureters are not visualized.
Risk stratification

• Antenatal
  • Gestational age
  • AP diameter, SFU grade, modifiers (incl. oligohydramnios)
  • Normal, Low Risk, Increased Risk

• Postnatal
  • AP diameter, SFU grade
  • Normal, Low Risk, Intermediate Risk, High Risk
Prenatal Presentation

16-27 wks AP RPD
4 to <7mm

16-27 wks AP RPD
4 to <7mm

≥ 28 wks AP RPD
7 to <10mm

≥ 28 wks AP RPD
≥ 7mm

≥ 28 wks AP RPD
≥ 10mm

Central calyceal dilation*

Parenchymal thickness normal

Parenchymal appearance normal

Ureters normal

Bladder normal

No unexplained oligohydramnios

UTD A1: LOW RISK

Peripheral calyceal dilation*

Parenchymal thickness abnl

Parenchymal appearance abnl

Ureters abnormal

Bladder abnormal

Unexplained oligohydramnios**

UTD A2-3: INCREASED RISK

*Central and peripheral calyceal dilation may be difficult to evaluate early in gestation

**Oligohydramnios is suspected to result from a GU cause
Prenatal Presentation

16-27 wks
AP RPD
4 to <7mm

16-27 wks
AP RPD
≥ 7mm

≥ 28 wks
AP RPD
7 to <10mm

≥ 28 wks
AP RPD
≥ 10mm

Central calyceal dilation*

Parenchymal thickness normal

Parenchymal appearance normal

Ureters normal

Bladder normal

No unexplained oligohydramnios

UTD A1: LOW RISK

Peripheral calyceal dilation*

Parenchymal thickness abnl

Parenchymal appearance abnl

Ureters abnormal

Bladder abnormal

Unexplained oligohydramnios**

UTD A2-3: INCREASED RISK

*Central and peripheral calyceal dilation may be difficult to evaluate early in gestation

**Oligohydramnios is suspected to result from a GU cause
Increased echogenicity

Peripheral dilation

<10 mm

Hydroureter

UTD A2-3: INCREASED RISK
POSTNATAL PRESENTATION

- > 48 hour AP RPD 10 to < 15mm
  - No peripheral calyceal dilation
    - Parenchymal thickness normal
      - Parenchymal appearance normal
        - Ureters normal
          - Bladder normal
            - UTD P1: LOW RISK

- > 48 hour AP RPD ≥ 15mm
  - Peripheral calyceal dilation
    - Parenchymal thickness normal
      - Parenchymal appearance normal
        - Ureters abnormal
          - Bladder normal
            - UTD P2: INTERMEDIATE RISK

- > 48 hour AP RPD ≥ 15mm
  - Peripheral calyceal dilation
    - Parenchymal thickness abnormal
      - Parenchymal appearance abnormal
        - Ureters abnormal
          - Bladder abnormal
            - UTD P3: HIGH RISK
RISK-BASED MANAGEMENT, PRENATAL DIAGNOSIS

UTD A1: LOW RISK

PRENATAL PERIOD:
One additional US after 32 wks

AFTER BIRTH:
Two additional US:
1. > 48 hrs to 1 month
2. 1-6 months later

OTHER:
Aneuploidy risk modification if indicated

UTD A2-3: INCREASED RISK

PRENATAL PERIOD:
Initially at 4 to 6 wks

AFTER BIRTH:
US at > 48 hours to 1 month of age

OTHER:
Specialist consultation, e.g. nephrology, urology
The choice to utilize prophylactic antibiotics or recommend VCUG will depend on the suspected underlying pathology.
Additional Considerations

• Worsening UTD associated with increased risk of GU pathology
• Laterality (unilateral vs. bilateral)
  – No recommendation (lack of evidence)
  – Consider *worse side* in risk stratification
• Gender
  – No recommendation (lack of evidence)
  – In male patients, consider posterior urethral valve
Caution!

- Risk stratification and recommendations NOT applicable to:
  - Solitary kidney
  - Postoperative findings
- Based on current literature (limited, inconsistent), expert opinion, and consensus (compromise)
- Not yet validated
  - Modifications to be based on clinical experience/research
What to tell the pediatricians?

• By adapting the UTD classification (in our reports) we would be:
  – Educating the caregiver(s)
  – Help distribute this new consensus
  – Shared decision-making diagnosis/ treatment/ recommendations
Thank you!