ISUOG Basic Training

Distinguishing between Normal & Abnormal Appearances of the Urinary Tract
Learning objectives

At the end of the lecture you will be able to:

• Describe how to obtain the 2 planes required to assess the fetal urinary tract & umbilical arteries correctly

• Recognise the differences between the normal & most common abnormal ultrasound appearances of the urinary tract
Key questions

1. What are the key ultrasound features of plane 13 (kidneys)?
2. What are the key ultrasound features of plane 14 (bladder)?
3. What probe movements are required to move from plane 13 (kidneys)? to plane 14 (bladder)?
4. Which abnormalities should be excluded after correct assessment of planes 13 (kidneys)? & 14 (bladder)?
<table>
<thead>
<tr>
<th>Anatomical area</th>
<th>Plane</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview 1</td>
<td>Sweep 1</td>
<td>Longitudinal head &amp; body for initial orientation</td>
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<tr>
<td>Spine</td>
<td>1</td>
<td>Sagittal complete spine with skin covering</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Coronal complete spine</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Coronal section of body</td>
</tr>
<tr>
<td>Head</td>
<td>4</td>
<td>Transventricular plane*</td>
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<tr>
<td></td>
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<td>Transthalamic plane*</td>
</tr>
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<td>6</td>
<td>Transcerebellar plane*</td>
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<tr>
<td>Thorax</td>
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<td>Lungs, 4 chamber view of heart</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Left ventricular outflow tract (LVOT)</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Right ventricular outflow tract (RVOT) &amp; crossover of LVOT</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>3 vessel trachea (3VT) view of heart</td>
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* measurement required
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<tr>
<td>Abdomen</td>
<td>11</td>
<td>Transverse section of abdomen with stomach &amp; umbilical vein*</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Transverse section of abdomen at cord insertion</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Transverse section(s) of left kidney &amp; pelvis, right kidney &amp; pelvis</td>
</tr>
<tr>
<td>Pelvis</td>
<td>14</td>
<td>Transverse section of pelvis, bladder, both umbilical arteries</td>
</tr>
<tr>
<td>Limbs</td>
<td>15</td>
<td>Femur diaphysis length*</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>3 bones of both legs, both feet &amp; normal relationships to both legs</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>3 bones of both arms, both hands &amp; normal relationships to both arms</td>
</tr>
<tr>
<td>Face</td>
<td>18</td>
<td>Coronal view of upper lip, nose &amp; nostrils</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>Both orbits, both lenses</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>Median facial profile</td>
</tr>
<tr>
<td>Overview 2</td>
<td>Sweep 2</td>
<td>Transverse sweep of body from neck to sacrum, one vertebra at a time</td>
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## Requirements from each plane

<table>
<thead>
<tr>
<th>Plane</th>
<th>Description</th>
<th>Structures to be evaluated(^2,3,4)</th>
<th>Measurement &amp; criteria for referral</th>
<th>Abnormalities that can be excluded from the normal appearances of the section</th>
</tr>
</thead>
</table>
| 13    | Transverse section of left kidney & pelvis, right kidney & pelvis            | Both kidneys & pelves                  | Refer if one or both renal pelves >7 mm AP | Bilateral renal agenesis  
Renal pelvic dilatation (upper limit of normal = 7 mm AP)  
Cystic renal dysplasia (unilateral/bilateral) |
| 14    | Transverse section of pelvis, bladder, both umbilical arteries               | Bladder & umbilical arteries, genitalia* | 2 vessel cord  
Lower urinary tract obstruction | |
### Moving through the 20 planes

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From plane 10 to 11 - slide
From plane 11 to 12 – slide
From plane 12 to 13 – slide (+ minimal rotations)
From plane 12 to 14 – slide
Plane 13 (kidneys)- imaging technique

- Longitudinal scan of spine
- Rotate counter-clockwise at the lumbar region & gently angle probe to visualise kidneys
Sagittal to transverse rotation of probe

Rotate the probe counter-clockwise & angulate slightly upwards or downwards, depending on the orientation
Structures to be evaluated during renal assessment

Plane 13 (kidneys)

- Renal outline (capsule)
- Renal pelvis
- Bowel may be mistaken for kidneys.
  - Identify kidneys by means of the renal pelvis
- If the renal pelvis appears subjectively dilated, measure the antero-posterior (AP) diameter in the transverse plane
- Always assess the kidneys in 2 planes to avoid errors
Assessment of the renal pelvis

- Measurement of renal pelvis done when they appear prominent
- Transverse section – symmetrical kidneys
- Measure AP diameter inner to inner
- Normal AP diameter = < 7 mm (16-27wks)
- > 7 mm – refer to a specialist
Renal pelvis assessment - caution

- Measurement should **NOT** be performed in the coronal plane
Plane 14 (cord insertion) - Transverse section of fetal lower abdomen showing bladder & umbilical cord insertion
Amniotic fluid volume assessment

• Surrogate indicator of renal function
• Starts increasing from 15-16 weeks
• Kidneys are the primary source of amniotic fluid from 15-16 weeks
• Good fetal activity is a sign of normal amniotic fluid volume
Bladder seen in coronal section
Colour Doppler assessment of three vessel cord
Abnormalities of the kidneys & bladder
Renal agenesis - unilateral

- Transverse section – 1 empty renal fossa
- Bladder seen
- Amniotic fluid volume normal if single kidney looks normal
Renal agenesis - bilateral

- After 16 weeks, severe oligohydramnios / anhydramnios present
- Transverse section – both renal fossae empty
- Absent bladder on persistent scanning

Refer if:
- Severe oligo/anhydramnios
- Persistent non visualisation of bladder, even if amniotic fluid normal
Bladder

Presence of a bladder & normal amniotic fluid is indicative of one or both functioning kidneys
Renal pelvic dilatation (RPD) / hydronephrosis

- Renal pelvis >7 mm AP
- Unilateral/bilateral
- Varying degrees
- Qualitative or quantitative
- Severe RPD = dilatation of central & peripheral calyces or >=15 mm AP
- May be static, progressive or resolving finding with gestation
Cystic renal dysplasia - bilateral

- Multiple cystic spaces of varying sizes
- Non-communicating
- Echogenic renal architecture
- Anhydramnios when bilateral non-functioning kidneys
Cystic renal dysplasia - unilateral

- Single functioning kidney – bladder & amniotic fluid volume normal
- Differential diagnosis – RPD / vesico-ureteric reflux (VUR) in contralateral kidney
Bilateral enlarged, bright kidneys

- Autosomal recessive polycystic kidneys
- Refer if kidneys enlarged &/or echogenic
Hydronephrosis unilateral - bilateral

- Renal pelvis > 7 mm AP
- Calyceal dilatation
Hydronephrosis – unilateral/bilateral

Normal

Unilateral hydronephrosis (left)

Bilateral RPD?
RPD – bladder appearances

- **Bladder normal**
  - Cause - upper urinary tract obstruction most likely

- **Bladder distended**
  - Cause - lower urinary tract obstruction (LUTO)
Obstructed bladder

- Very large, distended bladder
- Anhydramnios
- Bladder outlet obstruction most likely cause
Single umbilical artery
Key points

1. Fetal kidneys should be assessed in transverse & sagittal planes
2. Identification of the kidneys is by means of the renal capsule & the fluid in the renal pelvis
3. Renal pelvis diameter AP > 7 mm is abnormal
4. Amniotic fluid volume is an important determinant of renal function
5. Use of colour Doppler over area of cord insertion into the abdomen & para bladder helps identify the umbilical arteries
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