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)?

The 20 + 2 planes

Anatomical area	Plane	Description
Overview 1	Sweep 1	Longitudinal head & body for initial orientation
Spine	1 2 3	Sagittal complete spine with skin covering Coronal complete spine Coronal section of body
Head	4 5 6	Transventricular plane* Transthalamic plane* Transcerebellar plane*
Thorax	7 8 9 10	Lungs, 4 chamber view of heart Left ventricular outflow tract (LVOT) Right ventricular outflow tract (RVOT) & crossover of LVOT 3 vessel trachea (3VT) view of heart

* measurement required

The 20 + 2 planes

Anatomical area	Plane	Description
Abdomen	11 12 13	Transverse section of abdomen with stomach & umbilical vein* Transverse section of abdomen at cord insertion Transverse section(s) of left kidney & pelvis, right kidney & pelvis
Pelvis	14	Transverse section of pelvis, bladder, both umbilical arteries
Limbs	15 16 17	Femur diaphysis length* 3 bones of both legs, both feet & normal relationships to both legs 3 bones of both arms, both hands & normal relationships to both arms
Face	18 19 20	Coronal view of upper lip, nose & nostrils Both orbits, both lenses Median facial profile
Overview 2	Sweep 2	Transverse sweep of body from neck to sacrum, one vertebra at a time

* measurement required

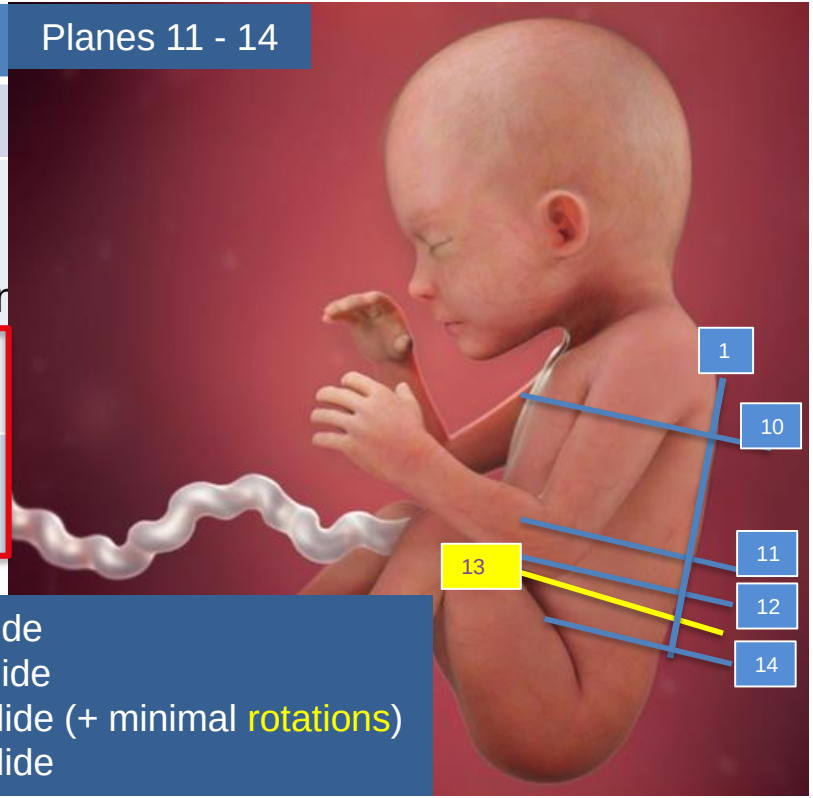
Requirements from each plane

Plane	Description	Structures to be evaluated[2,3,4]	Measurement & criteria for referral	Abnormalities that can be excluded from the normal appearances of the section
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

Practice guidelines for performance of the routine midtrimester scan, UOG, 2010, 37: 116-126
Sonographic examination of the fetal central nervous system, UOG, 2007, 29(1): 109-116
ISUOG Practice Guideline (updated): sonographic screening examination of the fetal heart, UOG, 2013, 41(3): 348-359
*optional, for local decision as to whether or not included

Moving through the 20 planes

Plane	Description
10	3 vessel trachea (3VT) view of heart
11	Transverse section of abdomen with stomach & umbilical vein*
12	Transverse section of abdomen at cord insertion
13	Transverse section(s) of left kidney & pelvis, right kidney & pelvis
14	Transverse section of pelvis, bladder, both umbilical arteries



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

* measurement required

Plane 13 (kidneys)- imaging technique

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

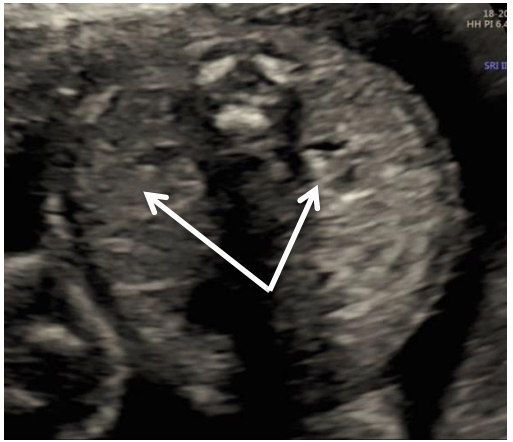
Sagittal to transverse rotation of probe

Rotate the probe counter-clockwise & angulate slightly upwards or downwards, depending on the orientation

Structures to be evaluated during renal assessment

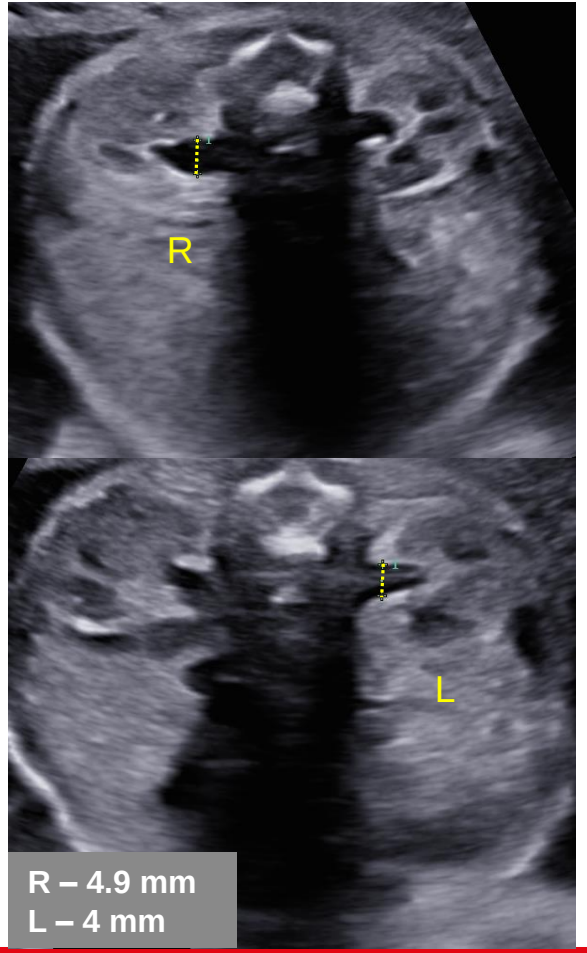
Plane 13 (kidneys)

- 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

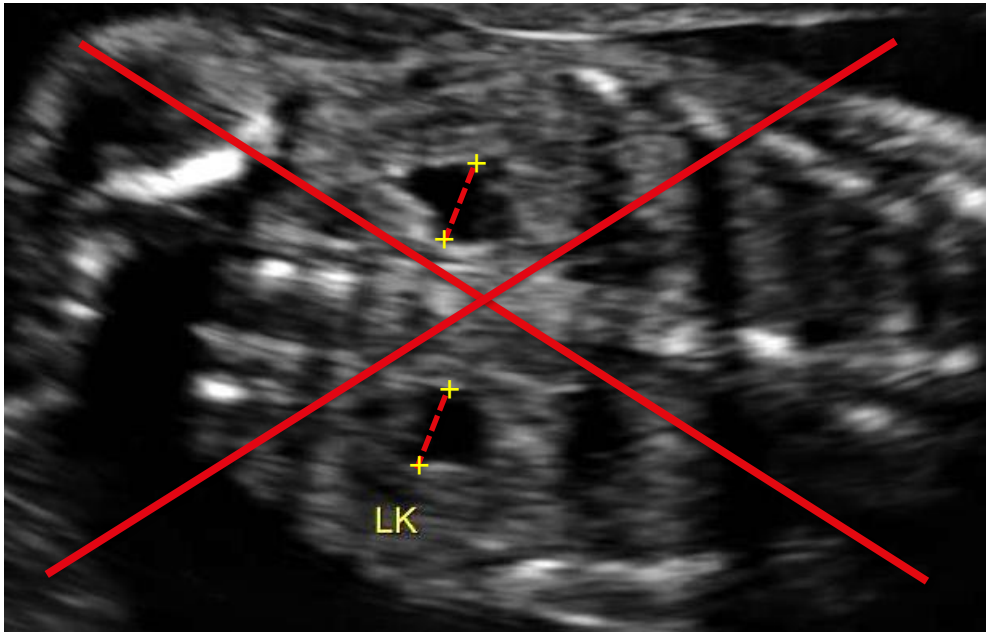


Assessment of the renal pelvis

- 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



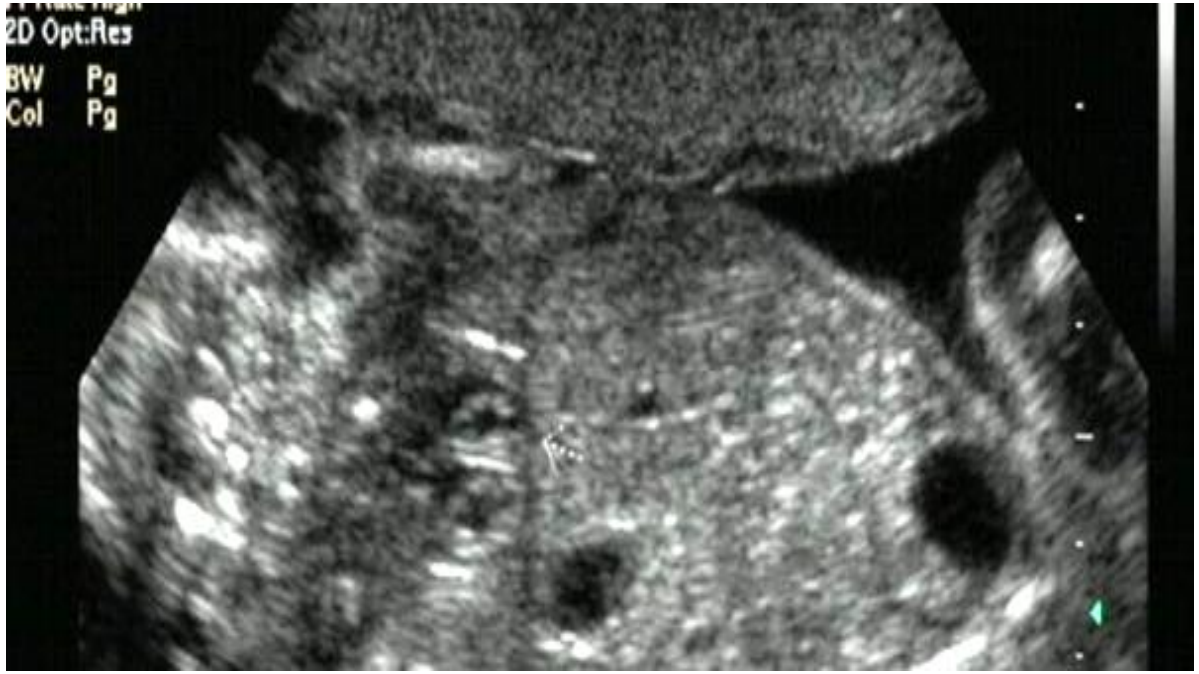
- Measurement should **NOT** be performed in the coronal plane

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

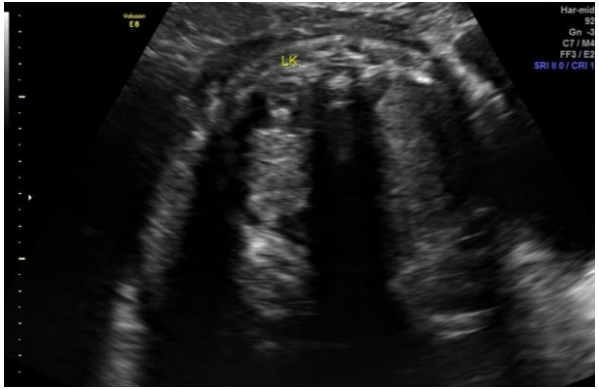
Bladder seen in coronal section



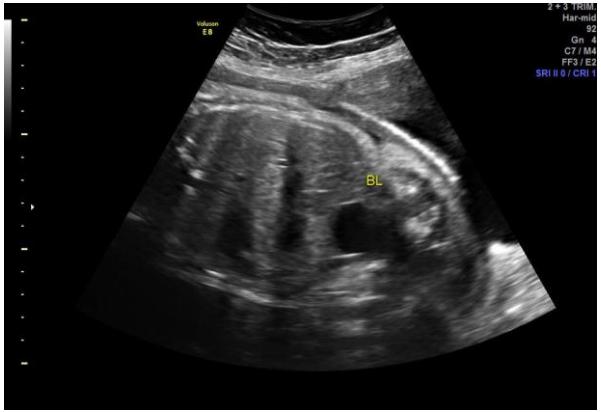
Colour Doppler assessment of three vessel cord

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



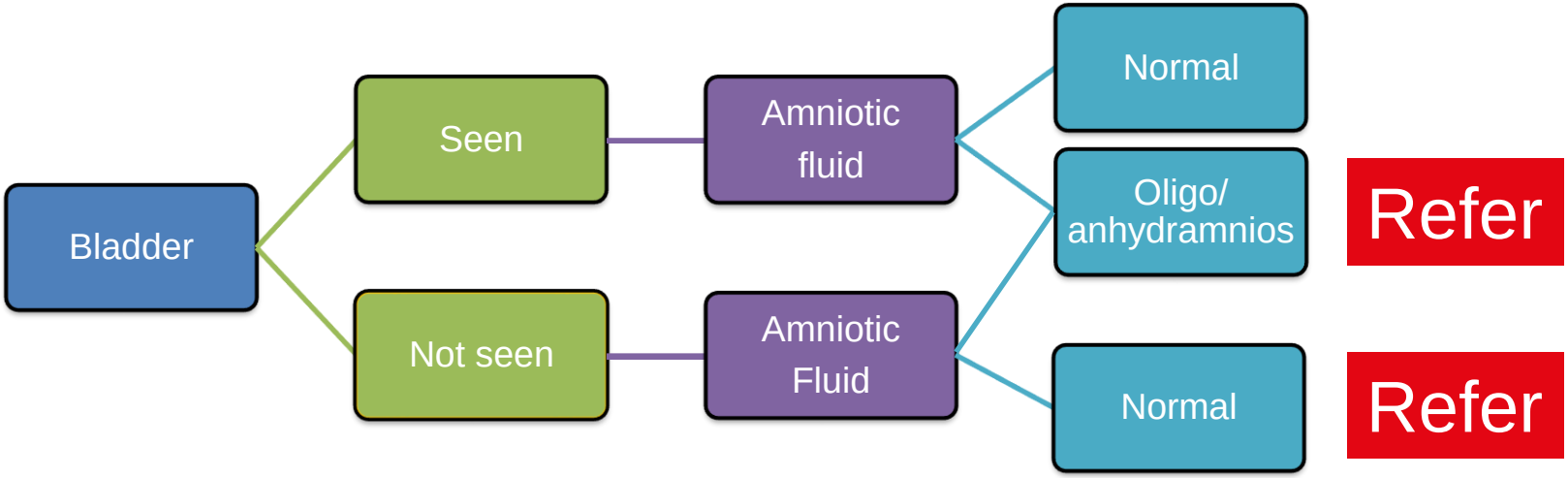
Renal agenesis - bilateral

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

Refer if:

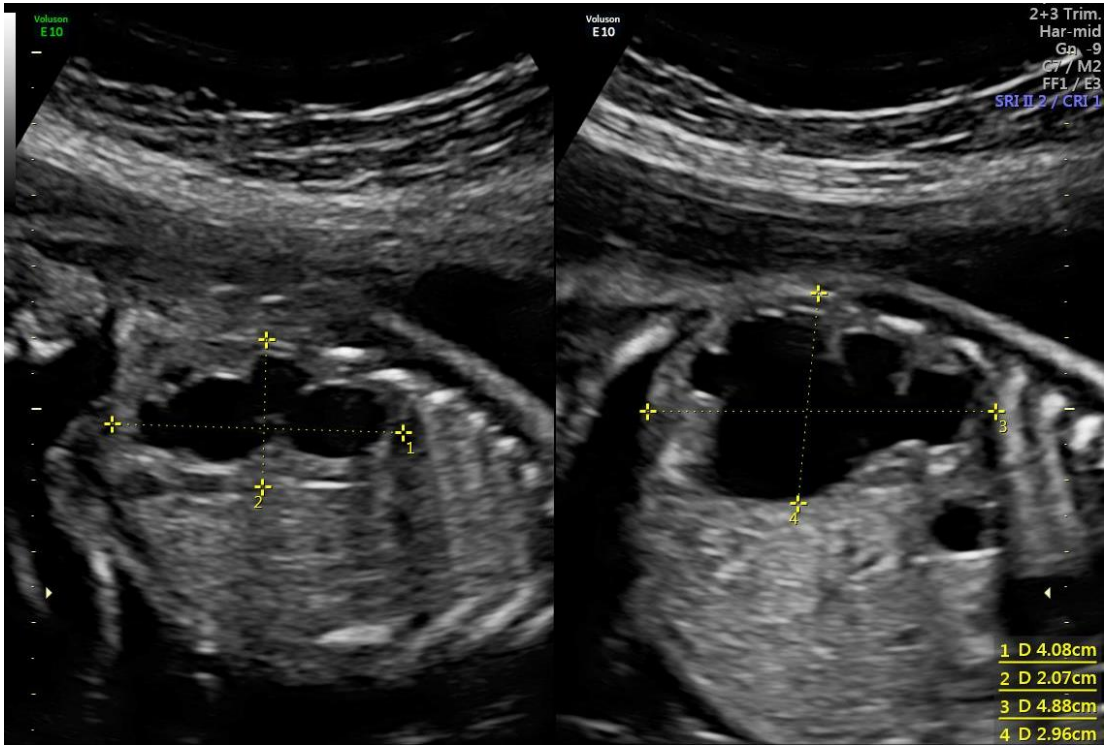
- Severe oligo/anhydramnios
- Persistent non visualisation of bladder, even if amniotic fluid normal

Bladder



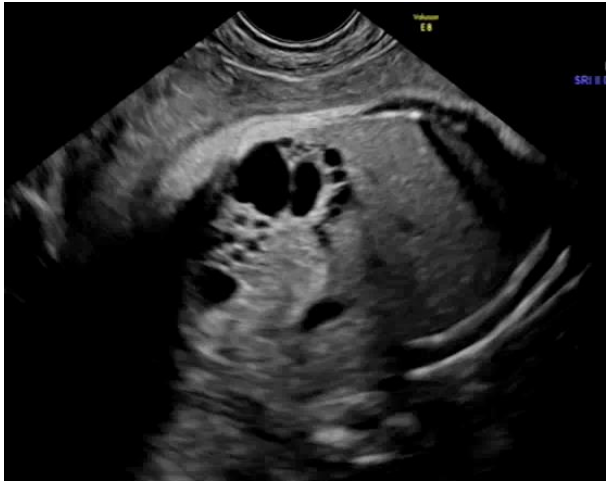
Presence of a bladder & normal amniotic fluid is indicative of one or both functioning kidneys

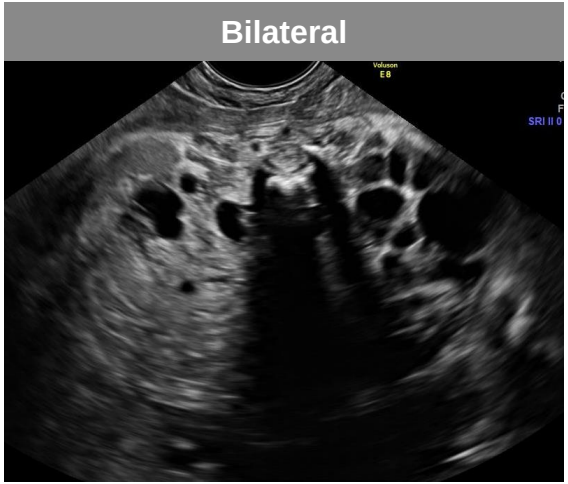
Renal pelvic dilatation (RPD) / hydronephrosis

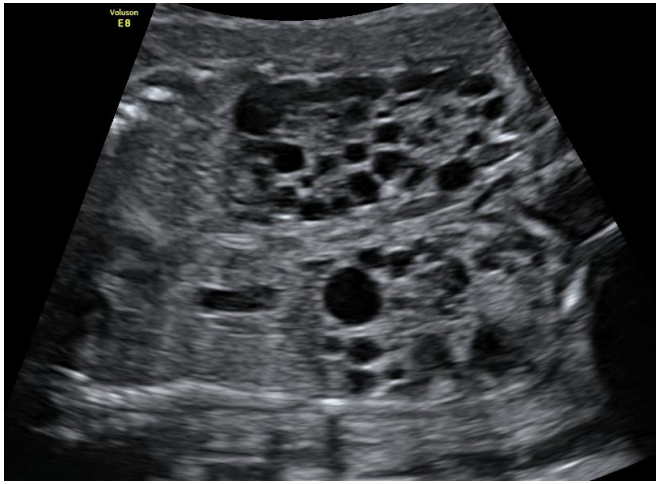


- Renal pelvis >7 mm AP
- Unilateral/bilateral
- Varying degrees
- Qualitative or quantitative
- Severe RPD = dilatation of central & peripheral calyces or >=15 mm AP
- May be static, progressive or resolving finding with gestation

Cystic renal dysplasia - bilateral





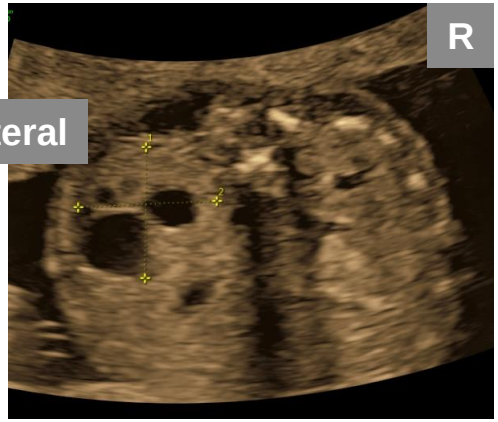


- Multiple cystic spaces of varying sizes
- Non-communicating
- Echogenic renal architecture
- Anhydramnios when bilateral non-functioning kidneys

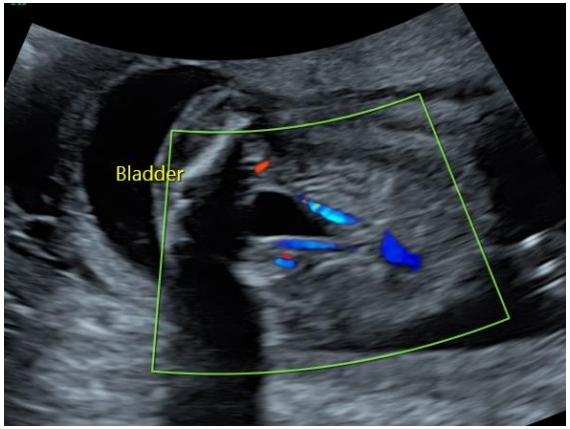
Cystic renal dysplasia - unilateral

Left: multicystic dysplastic

Unilateral



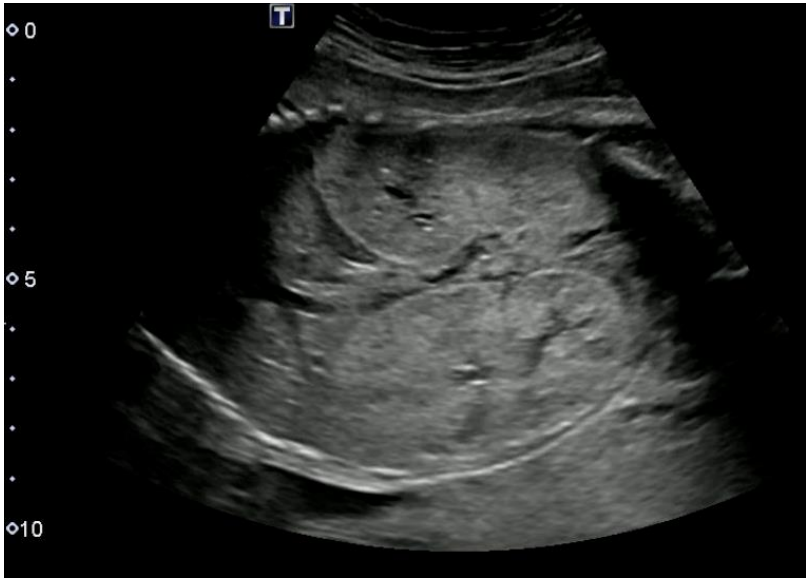
Right: normal



Bladder normal
in appearance & size

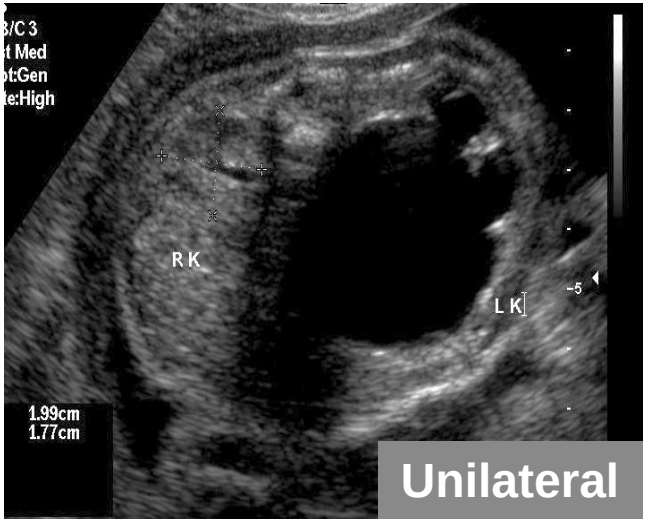
- Single functioning kidney – bladder & amniotic fluid volume normal
- Differential diagnosis – RPD / vesico-ureteric reflux (VUR) in contralateral kidney

Bilateral enlarged, bright kidneys



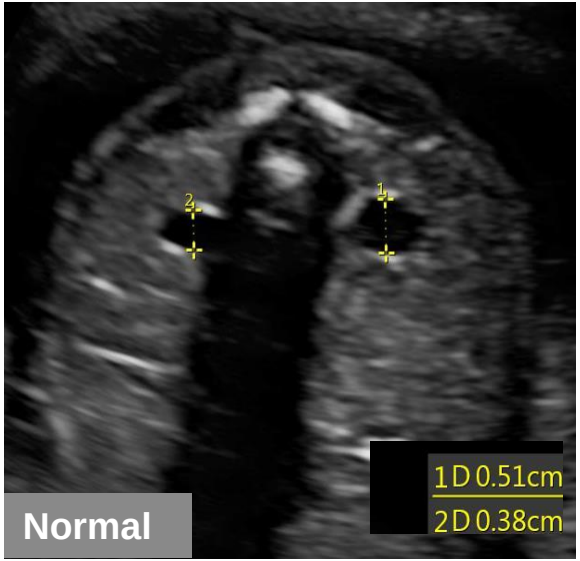
- Autosomal recessive polycystic kidneys
- Refer if kidneys enlarged &/or echogenic

Hydronephrosis unilateral - bilateral

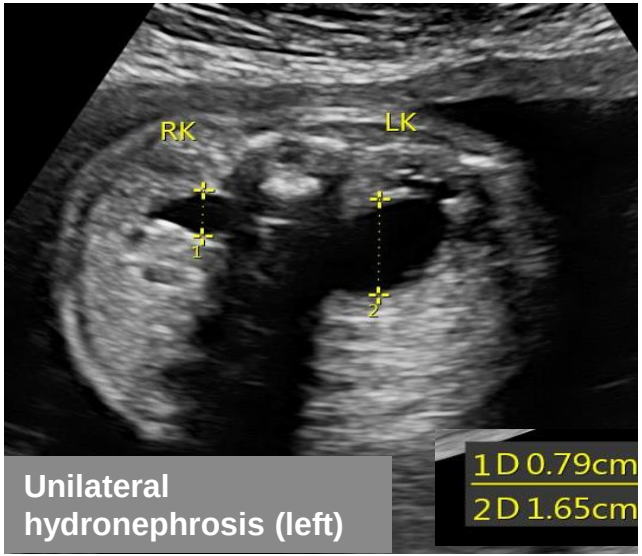


- Renal pelvis > 7 mm AP
- Calyceal dilatation

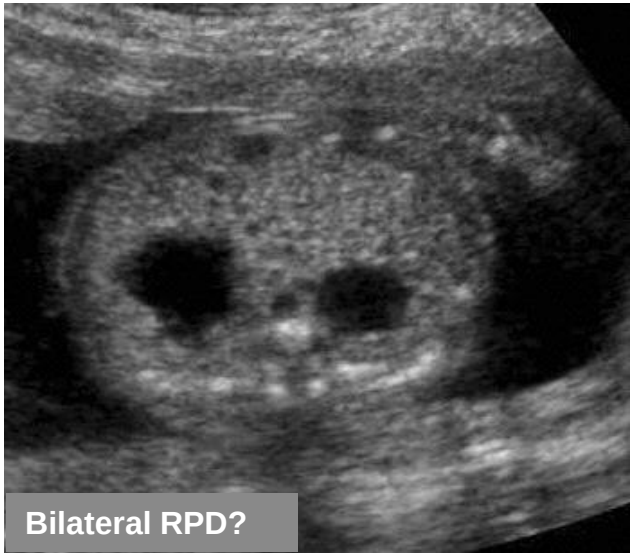
Hydronephrosis – unilateral/bilateral



Normal

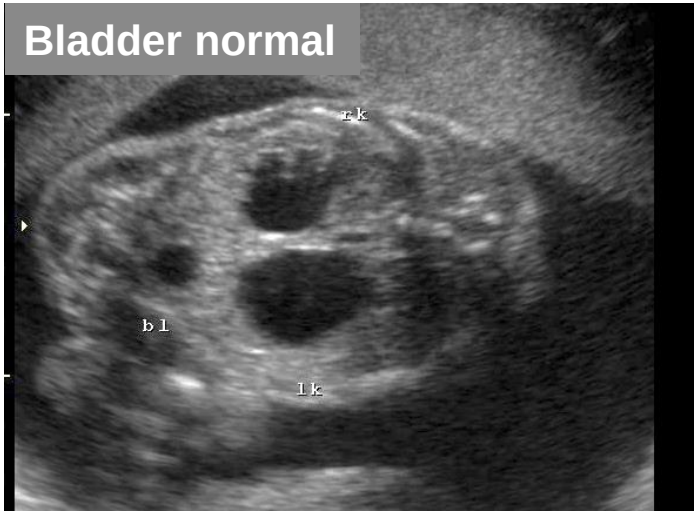


Unilateral hydronephrosis (left)



Bilateral RPD?

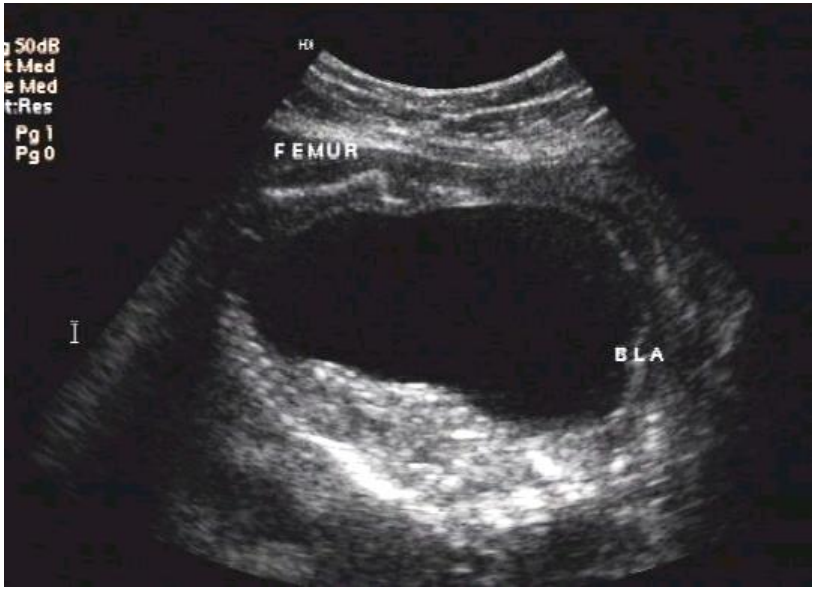
RPD – bladder appearances



- Cause - upper urinary tract obstruction most likely

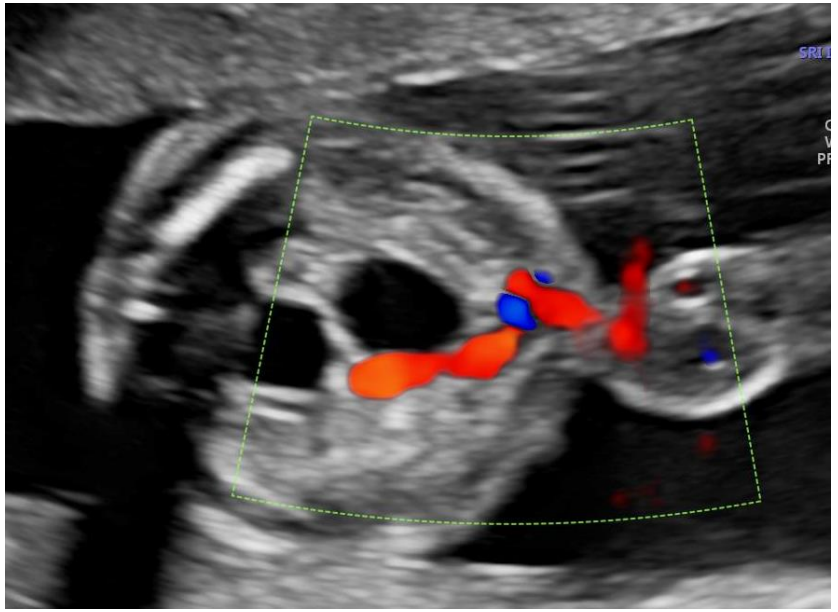
- Cause - lower urinary tract obstruction (LUTO)

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