Prenatal evaluation of fetal urinary bladder and associated anomalies

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Learning objectives

The purposes of this exhibition are to review the radiologic findings of variable conditions of fetal urinary bladder and associated anomalies.

Background

Evaluation of the fetal urinary bladder is important to detect the associated anomalies of urinary tract and other fetal organs. Recently we have experienced many cases of urinary tract anomalies associated with normal and abnormal feature of urinary bladder.

Imaging findings OR Procedure details

1. Normal urinary bladder of fetus (Figure 1-2.)

The fetal urinary bladder is well visualized during the 1st trimester. In many instance, however, the bladder is not visualized during the US exam without definite abnormality.

Although the fetus normally fills and empties bladder every 30 to 45 minutes, urinary bladder is visualized during the US exam in the 2nd and 3rd trimester.

The bladder wall is very thin and located in the central pelvis. Bilateral internal iliac arteries run around the bladder and branch the umbilical arteries, which is the differential finding of normal bladder from other intra-abdominal cystic lesions.

2. The detection of Large urinary bladder during 1st trimester

The normal size of the urinary bladder During the 1st trimester is smaller than 7mm.

Megacystis during the 1st trimester usually associated with bladder outlet obstruction such as posterior urethral valve (Figure 3.) and cloacal malformation (Figure 4.).

- Posterior urethral valve occurs in the male only.
- Almost cloacal malformation occurs in female.
The outcome of bladder outlet obstruction is usually poor without proper treatment, and is associated with other fetal anomalies in many cases.

3. Invisible urinary bladder during 2nd & 3rd trimester

Invisible bladder during the 2nd & 3rd trimester usually needs careful radiological evaluation of the fetus and estimation of amniotic fluid volume.

Invisible bladder with severely decreased amniotic fluid means impairment of urine production caused by bilateral renal agenesis, bilateral MCDK, autosomal recessive polycystic kidney, and syndromes such as sirenomelia and Meckel-Gruber syndrome.

Invisible bladder with normal amniotic fluid may be associated with bladder extrophy.

<In case of invisible Bladder with Anhydramnios>

1> Bilateral Renal Agenesis (Figure 5.)

2> Sirenomelia (Figure 6.)

- Sirenomelia is a rare and invariably lethal congenital anomaly characterized by fusion of the lower extremities and the presence of other severe anomalies, such as bilateral renal agenesis.
- Fusion of the lower extremities in sirenomelia ranges from membranous fusion of the soft tissue to total fusion of the lower legs with one midline femur.
- Severe oligohydramnios, a sonographic marker of an absent or non-functioning kidney, may obscure prenatal sonographic evaluation of the condition.

3> Bilateral Renal Cystic Diseases

- Bilateral renal cystic diseases, including ARPCKD (Figure 7.), MCDK (Figure 8.) and other cystic dysplasia, cause impairment of urine production, resulting in invisible bladder and severe oligohydramnios.

ARPCKD (Autosomal Recessive Polycystic Kidney Disease)

Bilateral MCDK (Multi-Cystic Dysplastic Kidney)
4> Meckel-Gruber Syndrome (Figure 9.)

- Rare, lethal, ciliopathic, genetic disorder, characterized by renal cystic dysplasia, central nervous system malformations, polydactyly, hepatic developmental defects, and pulmonary hypoplasia due to oligohydramnios

>In case of Invisible Bladder with Normal Amniotic Fluid Volume>

Invisible fetal urinary bladder with normal amniotic fluid is common condition due to fetal urination. In most cases the bladder is filled within 30 minutes.

1> Bladder exostrophy (Figure 10.)

- The bladder exstrophy is the result of a deficiency in development of the lower abdominal wall musculature, so that the bladder is open and the mucosa of the bladder is continuous with the skin.
- Bladder cannot contain the urine and is invisible on the prenatal image. However kidneys are usually normal and the volume of amniotic fluid is normal.

4. The detection of large urinary bladder during 2nd & 3rd trimester

Megacystis during the 2nd & 3rd trimester usually associated with bladder outlet obstruction such as

- Posterior urethral valve (Figure 11.)
- Urethral atresia (Figure 12.)
- Cloacal malformation (Figure 13.).

5. The another abnormal findings of urinary bladder on fetal ultrasound

Ureterocele (<= Abnormal intravesical cyst) (Figure 14.)

- A congenital abnormality found in the ureter
- The distal ureter balloons at its opening into the bladder, forming a sac-like pouch
- Often associated with a duplicated collection system

Cyst around urinary bladder
• Many cystic lesions around the fetal urinary bladder, including ovarian cyst, duplication cyst, seminal vesicle cyst, MCDK of pelvic kidney can develop during the fetal life.

1. Seminal vesicular cyst & Unilateral Renal Agenesis (Figure 15.)
2. Ovarian Cyst (Figure 16-17.)
3. Pelvic MCDK: multicystic dysplastic change of ectopic kidney (Figure 18.)

Images for this section:

![Fig. 1: Transvaginal US findings of urinary bladder and kidneys of a 12-week fetus. The coronal (A) and axial (B) images show small round bladder (arrow) in the center of pelvic cavity and both kidneys (small arrows).](image-url)
Fig. 2: US and MRI findings of normal urinary bladder and kidneys of a 30-week fetus. (A) The bladder wall is thin and the internal content is anechoic fluid. (B) CDUS reveals bilateral umbilical arteries (arrows) running around the urinary bladder. (C & D) Fetal MRI shows well-defined fetal urinary bladder (arrows) and surrounding structures.
Fig. 3: US findings of the posterior urethral valve in a fetus at 11th and 13th weeks. (A & B) US at 11 week shows markedly dilated fetal urinary bladder. (C) The follow-up US at 13 week demonstrates more dilated urinary bladder. (D) The echogenicity of both kidneys (arrows) is increased and the renal pelvis are dilated, suggesting cystic dysplasia of both kidneys.
Fig. 4: US and photography findings of the cloacal malformation of a fetus at 12th weeks. (A & B) Coronal and axial image show a large round cyst in the fetal pelvis abdomen. (C) CDUS reveals the umbilical cord connected to the anterior part of the cystic mass, suggesting this cystic mass is the dilated bladder. (D) The photography demonstrates marked dilatation of the fetal abdomen. Autopsy of the fetus confirmed cloacal malformation with obstruction of bladder outlet and imperforate anus.
Fig. 5: US findings of bilateral renal agenesis. (A) The axial image of the fetal abdomen shows anhydramnios. Both kidneys are invisible and the bowel loops fills the renal fossa (arrow). (B) The coronal image shows lying-down adrenal gland at the paraspinal area (small arrow). The urinary bladder was invisible during the US exam.
Fig. 6: Sirenomelia in a 20-week fetus. (A) The coronal CDUS image shows no renal arterial flow. Both kidneys and bladder are invisible. There is no amniotic fluid around the fetus. (B) Fetal MRI shows single extended femur (arrow). The bladder is not visualized and there is no amniotic fluid around the fetus. (C) Postmortem radiograph shows a single lower extremity and hypoplastic pelvic bone. Autopsy of the fetus revealed bilateral renal agenesis and tracheo-esophageal fistula, suggesting sirenomelia.
**Fig. 7:** US and autopsy findings of a fetus with ARPCK. (A) Both kidneys (arrows) are enlarged with increased parenchymal echo and collapsed renal pelvis. There is no amniotic fluid around fetus. (B) Photography of the cut surface shows innumerable tiny cysts in the enlarged kidney.

**Fig. 8:** US findings of bilateral MCDK. (A) There are multiple variable size cysts in both kidneys without normal parenchymal echo. The amount of amniotic fluid is markedly decreased. (B) On the power Doppler US, there is no renal arterial flow from the aorta.
**Fig. 9:** US findings of Meckel-Gruber Syndrome. (A) Coronal image of a fetal abdomen shows multiple cysts in both kidneys, suggesting multicystic dysplasia. The amount of amniotic fluid is markedly decreased. (B) Axial image of fetal head shows a protruding cyst (arrow) in the occipital area with disruption of occipital bone, suggesting occipital encephalocele.

**Fig. 10:** US findings of bladder exstrophy of a 23-week fetus. (A) Prenatal US of lower abdomen shows protruding mass (arrow) in the lower anterior abdomen instead of normal urinary bladder. The amniotic fluid volume is normal. (B) Coronal image of fetal abdomen reveals a normal kidney.

**Fig. 11:** US findings of posterior urethral valve of a 30-week fetus. (A) The coronal image shows dilated bladder and posterior urethra (arrow), forming "key-hole" appearance. The amniotic fluid is markedly decreased. (B) The bladder wall is thick with multiple trabeculation. Pelvis and calyces of both kidneys are dilated.
**Fig. 12**: US and autopsy findings of urethral atresia of a 22-week fetus. (A) Coronal image of the fetal abdomen shows multiple cystic changes of both kidneys and perirenal urine collection (arrow) in the left side. Both ureters are dilated (small arrows). Amniotic fluid is invisible. (B) Sagittal image shows markedly dilated urinary bladder. There is beaking of the upper urethra (small arrow), suggesting urethral atresia. (C) Autopsy reveals markedly dilated bladder and ureters (arrows) and multicystic changes of both kidneys. (D) Cut surface image of bladder reveals thickening of the wall and urethral atresia (arrow).
**Fig. 13:** US Findings of cloacal malformation of a 35-week fetus. (A) Coronal image shows markedly dilated two cystic lesions with apparent "fold" (arrow), suggesting communication of bladder and female genital tract. (B) Renal pelvis are dilated and the amniotic fluid is markedly decreased.

**Fig. 14:** US Findings of ureterocele with renal duplication of a 27-week fetus. (A) Coronal image of fetal pelvic cavity shows a small cyst in the urinary bladder, suggesting ureterocele (small arrow). (B) Coronal image of the right kidney shows renal duplication and dilatation of the upper pole pelvis. The upper moiety ureter is also dilated (arrow).
**Fig. 15:** US findings of unilateral renal agenesis. (A) The left kidney is not visualized. The left adrenal gland (small arrow) is located in the paraspinal area. (B) The left renal artery flow is not visualized on the power Doppler US. (C) Urinary bladder is normal. There is a small round cyst (arrow) in the left lower portion, which is confirmed seminal vesicle cyst. (D) Postnatal US reveals small cystic lesion at the left posterior portion of the bladder, suggesting seminal vesicle cyst.
**Fig. 16:** US findings of ovarian cyst of a 32-week fetus. (A) Sagittal image shows a large cystic lesion at the superior portion of the urinary bladder (UB). The internal fluid is anechoic. (B) The cyst is located in the left side and confirmed as left ovarian cyst after birth.

**Fig. 17:** US findings of hemorrhagic ovarian cyst of a 32-week fetus. (A) Axial image of the fetal abdomen shows a heterogeneous echogenic mass (arrow) at the left posterior portion of the bladder. (B) Postnatal US image reveals a cyst with echogenic debris, confirmed as hemorrhagic ovarian cyst.
Fig. 18: Prenatal US findings of pelvic kidney with multiple cystic dysplasia. (A) On the coronal image the right kidney is not visualized and the right adrenal gland (small arrow) is "lying down" in the right paraspinal area. (B) There are multiple variable sized cysts at the superior portion of urinary bladder (arrow) suggesting multicystic dysplastic change of ectopic right kidney.
Conclusion

Early detection and differential diagnosis of variable conditions of fetal urinary bladder and associated anomalies are very important.

Megacystis during the 1st trimester usually associated with bladder outlet obstruction such as posterior urethral valve and cloacal malformation.

Invisible bladder during the 2nd trimester usually needs careful radiological evaluation of the fetus and estimation of amniotic fluid volume.

Invisible bladder with severely decreased amniotic fluid means impairment of urine production caused by bilateral renal agenesis, bilateral MCDK, autosomal recessive polycystic kidney, and syndromes such as sirenomelia and Mekel-Gruber syndrome.

Large bladder in the 2nd trimester may be associated with bladder outlet obstruction due to urethral atresia, posterior urethral valve, and cloacal malformation.

References


Personal Information