Fetal hydronephrosis: Postnatal management

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INTRODUCTION

Fetal hydronephrosis (dilation of the renal pelvis) is a common, readily diagnosed finding on antenatal ultrasound examination, which may be a transient benign condition or be associated with significant congenital anomalies of the kidney and urinary tract (CAKUT). The goal of postnatal management of infants with fetal hydronephrosis is to identify those with clinically significant CAKUT while avoiding unnecessary testing in patients with physiologic or clinically insignificant hydronephrosis. In addition, early identification of infants with significant disease allows initiation of interventional therapy that may minimize adverse effects of CAKUT.

Postnatal management of infants diagnosed with fetal hydronephrosis is reviewed here. The definition, etiology, and prenatal issues of fetal hydronephrosis and specific urologic conditions that may present as fetal hydronephrosis are discussed separately. (See "Fetal hydronephrosis: Etiology and prenatal management" and "Congenital ureteropelvic junction obstruction" and "Primary megaureter in infants and children" and "Ectopic ureter".)

MANAGEMENT APPROACH

Goal — The goal of postnatal management of infants with fetal hydronephrosis is identifying patients with congenital anomalies of the kidney and urinary tract (CAKUT) while avoiding unnecessary testing in the majority of patients with physiologic or clinically insignificant fetal hydronephrosis. Evaluation includes physical examination and the use of imaging studies to detect abnormalities that will require postnatal intervention.

General principles — There is not a single test or finding that accurately differentiates infants with significant disease from those who are normal or have insignificant findings. In our practice, we use an approach based upon confirmation and severity of persistent postnatal hydronephrosis that limits unnecessary testing and minimizes parental/caregiver's distress (algorithm 1) [1-3]. The need for additional testing (eg, voiding cystourethrogram [VCUG]) is based on results of the initial postnatal ultrasound and the presence of other risk factors such as family history of clinically significant vesicoureteral reflux or CAKUT and findings of concern for neurogenic bladder (eg, imperforate anus, spinal abnormalities, myelomeningocele). (See "Fetal hydronephrosis: Etiology and prenatal management", section on 'Congenital anomalies of the kidney and urinary tract (CAKUT)'.)

It is important to remember that it is rarely necessary to operate on an obstructed kidney in a neonate in the first few days or weeks of life because the fetal kidneys start to make urine between the fifth and ninth week of gestation; therefore, an additional few days and/or weeks of observation after birth awaiting an accurate diagnosis rarely affects long-term outcome. In addition, the added anesthetic risk in the neonatal period needs to be taken into account. An important exception are patients with conditions that affect both kidneys, such as posterior urethral valves (PUV), who require intervention to relieve post-bladder obstruction as soon as possible after birth to preserve as much as possible both kidney and bladder function. (See "Management of posterior urethral valves", section on 'Postnatal management'.)

Physical examination — The neonatal physical examination can identify abnormalities that are indicative of congenital anomalies of the kidney and urinary tract (CAKUT), which are associated with fetal hydronephrosis. These include the following:

- The presence of an abdominal mass that could represent an enlarged kidney due to obstructive uropathy or multicystic dysplastic kidney (MCDK). (See "Congenital ureteropelvic junction obstruction" and "Renal cystic diseases in children", section on 'Multicystic dysplastic kidney'.)

- A palpable bladder in a male infant, especially after voiding, may suggest posterior urethral valves (PUV). PUV results in post-bladder obstruction and, as a result, bilateral kidney involvement. As a result, early evaluation is warranted. (See "Clinical presentation and diagnosis of posterior urethral valves".)

- A male infant with prune-belly syndrome will have deficient abdominal wall musculature and undescended testes. (See "Prune-belly syndrome".)

- The presence of outer ear abnormalities is associated with an increased risk of CAKUT. (See "Congenital anomalies of the ear", section on 'Association with kidney anomalies'.)

- A single umbilical artery is associated with an increased risk of CAKUT, particularly vesicoureteral reflux (VUR). (See "Assessment of the newborn infant", section on 'Umbilical cord'.)

- Spinal and/or lower extremity abnormalities suggesting a neurogenic bladder, which may result in hydronephrosis and dilated ureters. (See "Myelomeningocele (spina bifida): Urinary tract complications".)

Timing of initial postnatal ultrasound — Timing of the initial postnatal ultrasound is dependent on whether there is bilateral involvement or an affected solitary kidney versus unilateral involvement based on prenatal ultrasound. Initial ultrasound within 48 hours is performed for those who are at risk for bilateral involvement (eg, those with bilateral fetal hydronephrosis or a palpable bladder in a male infant suggestive of PUV).

Bilateral fetal hydronephrosis — For infants with bilateral hydronephrosis and those with a hydronephrotic **solitary** kidney with a renal pelvic diameter (RPD) >10 mm in the third trimester, postnatal ultrasound is performed within 48 hours of birth because of the increased likelihood of significant disease and a possible need for early intervention(algorithm 1). Infants with bilateral hydronephrosis are at-risk for post-bladder obstruction (eg, posterior urethral valves) that is best managed with prompt drainage and potential surgical correction, whereas significant hydronephrosis in a solitary kidney may be due to severe reflux, ureteral ectopy, and/or an ureterocele. Prompt attention is required, as these infants may also require early intervention with a focus on preserving kidney function.

If the postnatal ultrasound demonstrates persistent hydronephrosis, a voiding cystourethrogram (VCUG) should be performed to identify cases of post-bladder obstruction (eg, PUV) or bilateral VUR. (See "Clinical presentation and diagnosis of posterior

urethral valves", section on 'Diagnosis' and "Clinical presentation, diagnosis, and course of primary vesicoureteral reflux", section on 'Diagnosis' and 'Persistent moderate to severe hydronephrosis' below.)

Unilateral fetal hydronephrosis — In newborns with clinically significant unilateral fetal hydronephrosis (prenatal RPD >10 mm on an antenatal ultrasound performed in the third trimester) with a normal-appearing contralateral kidney, ultrasonography should be performed when the infant returns to birth weight usually within the first two to four weeks of life. The delay in performing the postnatal ultrasound allows the infant to return to a normal volemic state as hypovolemia may decrease urinary flow and hydronephrosis may be missed or significantly reduced. (See 'Ultrasonography' below.)

Management based on postnatal ultrasound results — Management decisions are based on the severity of hydronephrosis. Severity is determined by measuring the anterior-posterior pelvic diameter (referred to as renal pelvic diameter [RPD]) on postnatal ultrasound or Society of Fetal Urology (SFU) grading system (image 1).

- <10 mm – Normal or mild hydronephrosis. SFU grade 1.
- 10 to 15 mm – Moderate hydronephrosis. SFU grade 2.
- >15 mm – Severe hydronephrosis; these infants are at the greatest risk for significant kidney disease, which may require surgical correction [4]. SFU grade 3 and 4.

Persistent moderate to severe hydronephrosis — For infants with persistent postnatal moderate to severe hydronephrosis (RPD >10 mm), and a dilated ureter a VCUG is performed to detect VUR (algorithm 1). VUR accounts for approximately 9 percent of cases of fetal hydronephrosis, but it is more common and severe in infants with persistent postnatal hydronephrosis [5]. Historically, VCUG was performed in all patients with findings suggestive of ureteral pelvic junction (UPJ) obstruction; however, there are now data that suggest children with classic UPJ-type obstruction with a normal bladder, nondilated ureter, and normal contralateral kidney have a low risk of significant VUR; therefore VCUG is not warranted in this group of patients [6,7]. (See "Clinical presentation, diagnosis, and course of primary vesicoureteral reflux" and "Congenital ureteropelvic junction obstruction", section on 'Antibiotic prophylaxis'.)

- **No reflux** – If the VCUG does **not** show VUR, further evaluation is dependent on the degree of hydronephrosis (algorithm 1).

- **Severe hydronephrosis** – In our center, infants with persistent postnatal **severe** hydronephrosis (RPD ≥15 mm) undergo further testing with a diuretic renography (renal scan with technetium-99m-mercaptoacetyltriglycine [Tc99mMAG3]) to detect possible obstruction. At this stage of evaluation, referral to a center with expertise in pediatric urologic care is warranted, because the renal scan is an invasive procedure requiring placement of an intravenous line and bladder catheter, and surgical interventions may be required if the kidney is obstructed. In general, diuretic renography can be performed after six weeks of life because surgical intervention is rarely required prior to this time (eg, severe hydronephrosis without VUR).

  The use of antibiotic prophylaxis in patients with severe hydronephrosis without VUR remains controversial and is discussed below.

- **Moderate hydronephrosis** – In our center, infants with **moderate** postnatal hydronephrosis (RPD 10 to <15 mm) have a repeat ultrasound when they reach four to six months of age. Further management decisions are made based on the subsequent ultrasound.

  - Resolution – The majority of cases with mild or moderate postnatal hydronephrosis resolve by 18 months of age [8-10].

  - Increasing hydronephrosis – If the degree of hydronephrosis increases, diuretic renography is performed to determine if there is an obstructive process. This is uncommon as illustrated by a retrospective study, which reported worsening hydronephrosis in 4 of 394 kidneys (1 percent) [11]. All four patients presented with clinical symptoms including abdominal pain, gross hematuria, and vomiting at a mean age of 40 months (range 22 to 60 months), consistent with a diagnosis of intermittent UPJO requiring pyeloplasty.

  - No change – We continue to monitor the degree of hydronephrosis with an ultrasound performed at one year of age, and if needed, between three and five years of age. In symptomatic cases, or if there is a marked increase in dilation, diuretic renography may be performed to determine if there is an obstructive process.

- **Reflux detected** – Therapeutic options are discussed with the family/caregivers and include observation, medical management including antibiotic prophylaxis, or surgical correction for more severe grades of reflux. Management of VUR

is discussed separately. (See "Management of vesicoureteral reflux", section on 'Therapeutic options'.)

Normal ultrasound or mild hydronephrosis — Infants with a normal postnatal examination or mild hydronephrosis (defined as an RPD ≤10 mm) without any evidence of any other genitourinary abnormality (ie, calyceal or ureteric dilation, or signs of renal dysplasia or anomalies) require no further evaluation. This approach is supported by follow-up data at two years of age and at 12 and 15 years of age that reported excellent outcome [12,13].

Prevention of UTI — Higher rates of urinary tract infections (UTIs) ranging from 3 to 7 percent have been reported in infants with prenatally diagnosed hydronephrosis compared with the general pediatric population [14-18]. The risk of infection rises if there is underlying VUR and is greater in girls compared with boys [16,18,19]. The risk also rises with the severity of fetal hydronephrosis [20]. In our practice, interventions used to reduce the risk of UTI include judicious use of antibiotic prophylaxis and treatment of physiologic phimosis with local steroid ointment in male infants with hydronephrosis.

Antibiotic prophylaxis — The use of prophylactic antibiotics for infants with fetal hydronephrosis remains controversial. It had been postulated that hydronephrosis was a risk factor for UTI due to urinary stasis; however, outcome data suggest that antibiotic prophylaxis may not be beneficial for patients with low-grade VUR and those with UPJ obstruction. (See "Management of vesicoureteral reflux", section on 'Antibiotic prophylaxis' and "Congenital ureteropelvic junction obstruction", section on 'Antibiotic prophylaxis'.)

In our practice, antibiotic prophylaxis is not generally administered to infants with low-grade and moderate-grade fetal hydronephrosis (ie, an RPD ≤12 mm, SFU [Society of Fetal Urology] grades I, II, III (image 1)) or patients with classic UPJ hydronephrosis (RPD 15 to 30 mm) [12,21]. Other centers provide prophylactic antibiotics for moderate hydronephrosis (ie, RPD between 10 to 15 mm); however, we feel this is unwarranted in patients with this degree of hydronephrosis. We reserve antibiotic prophylaxis for patients with dilated ureters (ectopic or refluxing), an enlarged bladder (eg, PUV), bilateral UPJ obstruction and patients with giant hydronephrosis (massively enlarged kidney with RPD >30 mm).

The evidence for this recommendation is based on a systematic review that included 21 studies in its final analysis [21]. The quality of the studies was judged to be high in five studies, moderate in eight studies, low in five studies, and very low in three studies. The following findings were noted:

- In patients with low-grade hydronephrosis (n = 2181 patients with SFU grades I and II), there was no difference in the rate of UTI between patients treated with continuous antibiotic prophylaxis and those who were not treated (2.2 versus 2.8 percent).

- In contrast, patients with high-grade hydronephrosis (n = 507 patients with SFU grades III and IV) who received continuous antibiotic prophylaxis had a lower rate of UTI compared with those who were not treated with antibiotics (14.6 versus 28.9 percent).

However, in our practice, patients with SFU grade III hydronephrosis are typically not given antibiotic prophylaxis unless family history is positive for UTI, VUR, or other uropathy [22].

If prophylactic antibiotics are used, the choice of antibiotics dependent on postnatal age:

- Less than three months of age – We typically use amoxicillin unless the child has a penicillin allergy. The dose for amoxicillin prophylaxis is 20 to 40 mg/kg orally once daily. Alternative choice is cephalexin.

- Older than three months of age, we generally suggest either:

  - Trimethoprim-sulfamethoxazole (TMP-SMX) – 2 mg TMP/kg as a single daily dose

  - Nitrofurantoin – 1 to 2 mg/kg as a single daily dose

Uncircumcised males — The risk of UTI is higher in males who are not circumcised. In our practice, we review the care of the uncircumcised penis with parents/caregivers, and if appropriate, treatment of physiologic phimosis with topical steroid ointment. (See "Care of the uncircumcised penis in infants and children", section on 'Physiologic phimosis'.)

We no longer routinely recommend circumcision to parents/caregivers of uncircumcised neonatal males with hydronephrosis. We review the data with the parents/caregivers regarding the risk of recurrent UTI in uncircumcised males with hydronephrosis [17] and offer the option of circumcision as a potential intervention to decrease the risk for future UTI. (See "Neonatal circumcision: Risks and benefits", section on 'Reduction in urinary tract infection'.)

IMAGING STUDIES

Ultrasonography — The preferred initial postnatal imaging study for infants with clinically significant fetal hydronephrosis is an ultrasound examination of the kidneys and bladder. Ultrasonography can detect most congenital anomalies of the kidney and urinary tract (CAKUT) associated with fetal hydronephrosis without radiation exposure [4,23]. The need and timing of the study depends upon the severity of the fetal hydronephrosis. In general, postnatal evaluation is performed for cases that reach a minimum **prenatal** renal pelvic diameter (RPD) of 10 mm based on an antenatal ultrasound performed in the third trimester, as RPDs below this level are unlikely to be associated with CAKUT. (See "Fetal hydronephrosis: Etiology and prenatal management", section on 'Congenital anomalies of the kidney and urinary tract (CAKUT)'.)

In general, examination should be avoided in the first two or three days after birth, because hydronephrosis may not be detected due to extracellular fluid shifts that will underestimate the degree of hydronephrosis. However, infants with bilateral hydronephrosis, those with significant ureteral dilation, and those with a hydronephrotic **solitary** kidney require more urgent evaluation within 48 hours of birth because of the increased likelihood of significant disease and a possible need for early intervention. (See 'Bilateral fetal hydronephrosis' above.)

In contrast, postnatal examination of infants with unilateral hydronephrosis and an unaffected normal-appearing contralateral kidney based on antenatal ultrasound should be delayed until the infant has fully regained birth weight, indicating a normal volume status (usually two to four weeks of age). In our practice, we typically wait until two to four weeks of age. (See 'Unilateral fetal hydronephrosis' above.)

Voiding cystourethrogram — A voiding cystourethrogram (VCUG) is performed as described above with persistent **postnatal** hydronephrosis (RPD ≥10 mm) to identify patients with bladder outlet obstruction, most commonly posterior urethral valves (PUV), and to detect vesicoureteral reflux (VUR) (algorithm 1). (See 'Persistent moderate to severe hydronephrosis' above and "Clinical presentation and diagnosis of posterior urethral valves", section on 'Diagnosis'.)

For this procedure, a urinary catheter is inserted into the bladder and contrast material is instilled. Fluoroscopic monitoring is performed while the bladder is filling and during voiding. Infants usually tolerate this procedure well. Although the duration of

fluoroscopy is minimized, the gonads, especially the ovaries, are exposed to radiation [24]. Newer techniques with radiopaque contrast bubbles detected by sonography thereby avoiding radiation are now being used [25].

Diuretic renography — Diuretic renography (renal scan and the administration of a diuretic, typically furosemide) is used to diagnose urinary tract obstruction in infants with severe persistent hydronephrosis after a VCUG has demonstrated no VUR [26]. It measures the drainage time from the renal pelvis, and assesses the relative contribution of each kidney to overall kidney function.

The test requires insertion of a bladder catheter to relieve any pressure that can be transmitted to the ureters and kidneys. Intravenous access is needed for hydration and the administration of the radioisotope and diuretic. The preferred radioisotope is technetium-99m-mercaptoacetyltriglycine (Tc99mMAG3), which is taken up by the renal cortex, filtered across the glomerular basement membrane (GBM) to the renal tubules, and excreted into the renal pelvis and urinary tract [27].

The study includes two phases:

- **Initial phase** – Radioisotope is injected intravenously and kidney parenchymal (cortical) uptake is measured during the first two to three minutes. The relative contribution of each kidney to overall kidney function referred to as **split kidney function** is assessed quantitatively. Split kidney function is the most useful measure to detect differences in kidney function between the two kidneys. As a rule of thumb, spilt kidney function of less than 5 percent difference is unlikely to be clinically significant.

  In patients with unilateral hydronephrosis (which is the most common clinical scenario), if the normal nonhydronephrotic kidney and hydronephrotic kidney both have similar function (ie, difference in split kidney function <5 percent), conservative management without surgery is a safe option. Subsequent studies can be compared with the initial baseline scan to determine whether kidney function remains stable or whether increasing differences in split kidney function develop that indicate a decrease in the function of the hydronephrotic kidney, most likely due to significant obstruction, which may require intervention [28].

- **Second phase** – In the second phase, at peak kidney uptake, intravenous furosemide is administered and the excretion of isotope from the kidney is measured (referred to as the "washout curve"). This phase indicates the extent of obstruction, if

present. In the normal kidney, the administration of furosemide results in a prompt washout. In a dilated system, if washout occurs rapidly after diuretic administration (<15 minutes), the system is not obstructed. If washout is delayed beyond 20 minutes, the pattern is consistent with obstructive uropathy. However, a delayed washout must be interpreted with caution [29,30]. As an example, in a series of 39 infants with antenatal unilateral hydronephrosis followed without surgery, diuretic renography indicated obstruction in 24 patients whose kidney function never decreased and thus could not have been obstructed [30]. These results may partly be due to the normally low neonatal glomerular filtration rate (GFR) that can be refractory to diuretic therapy. If washout is between 15 and 20 minutes, the study is considered indeterminate.

A number of factors can affect the accuracy of the diuretic renogram. This includes the state of hydration of the infant, the functionality of the bladder catheter, the timing of diuretic administration, the accuracy of physically outlining the kidney tissue in the presence of severe hydronephrosis, and the background effect from the liver and spleen.

Magnetic resonance urography — Magnetic resonance urography (MRU) in children is becoming more commonly used in the diagnosis and management of congenital uropathies, such as ureteropelvic junction obstruction (UPJO) [31,32]. MRU is especially useful in the management of obstructed kidneys that have rotation or ascent anomalies, or are single. MRU can more clearly define the anatomy and delineate the proper surgical approach (ie, retroperitoneal versus transperitoneal). The disadvantage of MRU is that the study often requires general anesthesia or heavy conscious sedation in infants and children. However, for patients in the newborn period, many centers are now performing "swaddle MRI" after the infant falls asleep after feeding, thus avoiding general anesthesia and conscious sedation. Another disadvantage is the use of the contrast agent gadolinium, which can only be used if the kidney function is normal (requiring a preprocedure serum creatinine test) because of reports of irreversible renal fibrosis in patients with kidney insufficiency. Newer MRU technology may even define obstruction, eliminating the need for diuretic renal scans.

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a

patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient education: Prenatal hydronephrosis (The Basics)")

SUMMARY AND RECOMMENDATIONS

- **Introduction** – Fetal hydronephrosis (fetal renal pelvic dilation) is a common, readily diagnosed finding on antenatal ultrasonography. (See 'Introduction' above.)

- **Goal** – The goal of postnatal management of infants with fetal hydronephrosis is identifying patients with congenital anomalies of the kidney and urinary tract (CAKUT) and limiting unnecessary studies and minimizing parental/caregiver's distress for the majority of infants with physiologic (transient) or clinically insignificant fetal hydronephrosis. (See "Fetal hydronephrosis: Etiology and prenatal management", section on 'Etiology'.)

- **Approach** – In our practice, we use an approach based upon confirmation of persistent postnatal hydronephrosis, which is detected on ultrasound, the preferred imaging modality. The need for additional testing (eg, voiding cystourethrogram [VCUG]) is based on results of the initial postnatal ultrasound and the presence of other risk factors such as finding consistent with neurogenic bladder and a family history of CAKUT. (See 'General principles' above and 'Ultrasonography' above.)

- **Timing of postnatal ultrasound**

- For infants with prenatal **bilateral hydronephrosis** and those with a **hydronephrotic solitary** kidney, postnatal ultrasound is performed within 48 hours of birth as these infants are at increased risk for significant CAKUT and possible need for early intervention (algorithm 1). (See 'Bilateral fetal hydronephrosis' above.)

- For infants with prenatal **unilateral hydronephrosis**, postnatal ultrasound is performed when the infant returns to birth weight (usually two to four weeks of life). (See 'Unilateral fetal hydronephrosis' above.)

- **Management based on severity of hydronephrosis** – Further management decision including additional testing is dependent on the severity of hydronephrosis based on postnatal ultrasound. (See 'Management based on postnatal ultrasound results' above.)

  - **Moderate to severe hydronephrosis** – For infants with moderate to severe hydronephrosis and a dilated ureter (renal pelvic diameter >10 mm), a VCUG is performed to detect the presence of vesicoureteral reflux. (See 'Persistent moderate to severe hydronephrosis' above and 'Voiding cystourethrogram' above.)

    - **No reflux and severe hydronephrosis** – Diuretic renography is performed to detect possible obstruction for infants with severe hydronephrosis (RPD >15 mm/SFU [Society of Fetal Urology] grade IV (image 1)) and no VUR. At this stage of evaluation, referral to a center with expertise in pediatric urologic care is warranted, because the renal scan is an invasive procedure requiring placement of an intravenous line and bladder catheter, and surgical interventions may be required if the kidney is obstructed. (See 'Diuretic renography' above.)

    - **Moderate hydronephrosis** – A repeat ultrasound is performed at four to six months of age. In the majority of cases, hydronephrosis will have resolved. For infants with increased hydronephrosis, a diuretic renal scan is performed.

  - **Normal or mild hydronephrosis** – No further evaluation is required for infants with a normal postnatal examination or mild hydronephrosis (defined as an RPD ≤10 mm) without evidence of any other kidney abnormality. (See 'Normal ultrasound or mild hydronephrosis' above.)

- Prevention of urinary tract:

- Prophylactic antibiotics – The use of prophylactic antibiotics for infants with fetal hydronephrosis remains controversial. It had been postulated that hydronephrosis was a risk factor for UTI due to urinary stasis; however, outcome data suggest that antibiotic prophylaxis may not be beneficial for patients with low-grade VUR and those with UPJ obstruction. As a result, in our practice, antibiotic prophylaxis is not generally administered to infants with low-grade and moderate-grade fetal hydronephrosis (ie, an RPD ≤12 mm, SFU [Society of Fetal Urology] grades I, II, III (image 1)) or patients with classic UPJ hydronephrosis (RPD 15 to 30 mm). (See 'Antibiotic prophylaxis' above and "Management of vesicoureteral reflux", section on 'Antibiotic prophylaxis' and "Congenital ureteropelvic junction obstruction", section on 'Antibiotic prophylaxis'.)

- Uncircumcised males – The risk of UTI is higher in males who are not circumcised. In our practice, we review the care of the uncircumcised penis with parents/caregivers, and if appropriate, treat physiologic phimosis with topical steroid ointment. We also offer the option of circumcision as a potential intervention to decrease the risk for future UTI.

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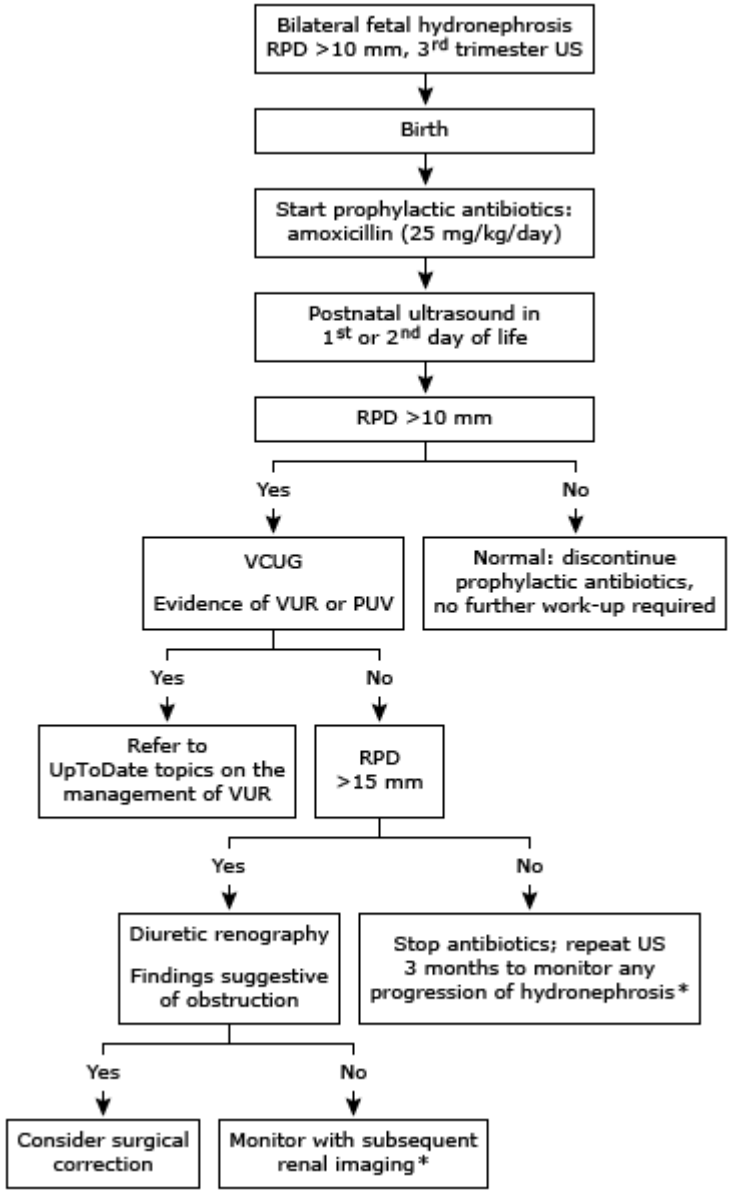
GRAPHICS

Postnatal evaluation of bilateral fetal hydronephrosis*

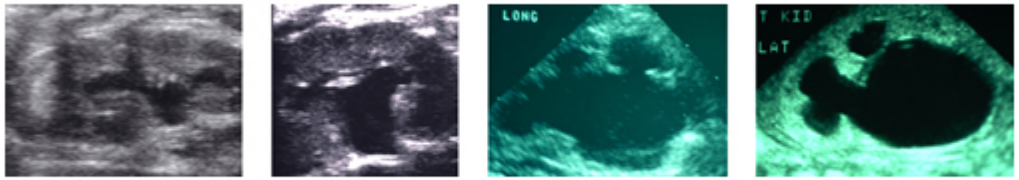


RPD: renal pelvic dilameter; VCUG: voiding cystourethrogram; VUR: vesicoureteral reflux; US: ultrasound; PUV: posterior uretheral valves.

* This algorithm is intended for use in conjunction with additional UpToDate content on postnatal evaluation of fetal hydronephrosis. Please refer to the topic on postnatal management of fetal hydronephrosis for more information.

Graphic 69172 Version 13.0

Society of Fetal Urology grading system for hydronephrosis



Grade 1 Grade 2 Grade 3 Grade 4

Grade 0: no dilation (not shown). Grade 1: renal pelvis is only visualized. Grade 2: renal pelvis as well as a few, but not all, calyces are visualized. Grade 3: virtually all calyces are visualized. Grade 4: similar to Grade 3, but when compared with the normal contralateral kidney, there is parenchymal thinning.

Graphic 50549 Version 4.0

Contributor Disclosures

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