Hydronephrosis in pregnancy: when does the ultrasound suffice?

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Learning objectives

To describe the ultrasound (US) features of hydronephrosis and its main causes in pregnant women, and to review the current criteria to perform complementary cross-sectional exams.
This work is a brief description of the most important causes of hydronephrosis during pregnancy based on an up-to-date review of the literature and patients' images from our institution.

Background

Due to an increased kidney filtration workload, hydronephrosis tends to develop faster and be more severe in pregnant women. If untreated or underdiagnosed, it could lead to renal damage and ultimately renal failure.

Most pregnant women have some degree of caliectasia and many present transient hydronephrosis due to external uterine compression of the ureter (1, 2) Positional changes alone may decrease the dilatation and relieve pain in symptomatic patients.(3, 4) However, other non-physiological causes should be considered and promptly recognized as it may imply an invasive approach.

Findings and procedure details

Clinical findings:

About 80% of pregnants are affected by physiological hydronephrosis. It is more pronounced on the right kidney and ipsilateral urinary pathways (4). The more plausible explanation is due to the compression of the ureters between the pregnant uterus and the linea terminalis or pelvic rim. Some authors state that high hormonal levels that occur normally during gestation are responsible for relaxation of smooth muscle cells lining the walls of the urinary pathways and may therefore contribute to hydronephrosis. (4)(fig. 1)

Usually slowly dilatation of the renal pelvis and urinary pathways does not elicit a pain response, only if the hydronephrosis develops at a faster rate pain is experienced, therefore the physiological hydronephrosis does not usually present with pain.
The clinical significance of hydronephrosis lies in the detection and differentiation of a physiological hydronephrosis and a true ureteral endoluminal obstruction. (fig. 1, 2, 3) The most likely obstructive causes are lithiasis, polyhydramnios and enlarged uterine fibroids. With the exception of intrinsic causes like lithiasis, delivery usually solves the situation, although ureteral stenting may be required preterm. (5)

Urolithiasis is the most common cause of non-obstetrical abdominal pain that requires hospitalization among pregnant patients. (fig.2) Urolithiasis usually develops later during pregnancy with 80 to 90% of pregnancies diagnosed after the first trimester (6). An increased rate of urinary tract stone formation is related to high levels of vitamin D produced by an overworking kidney and extra-placentary production, which results in hypercalciuria. With an incidence of 1 in 1500 pregnancies, ureteral stones are twice as frequent as in the renal pelvis and affect both sides equally, unlike physiological hydronephrosis that more commonly affects the right side.

True obstructive causes either extrinsic or intrinsic are usually symptomatic. Oliguria or anuria should always undergo prompt evaluation for depiction of obstructive uropathy. Other less specific findings like pain, vomiting, fever with chills and hematuria may coexist, depending on the subjacent cause.

Despite being initially asymptomatic, some conditions may complicate physiologic hydronephrosis. The most common complication associated with hydronephrosis is urinary tract infection. Hormonal and mechanical changes increase the risk of urinary stasis and vesicoureteral reflux. These changes, along with a short urethra (approximately 3-4 cm in females) and difficult hygiene due to a distended pregnant abdomen, increase the frequency of urinary tract infections. In the set of an underlying obstruction, pyonephrosis should be promptly recognized and treated as it is a true emergency. (fig. 3)

Imaging features

Although hydronephrosis is easy to recognize, its causes may not be as obvious particularly in pregnant subjects. Ultrasound should be the first-choice modality in the imaging evaluation of these patients as it is fast, accessible, and lacks ionizing radiation. (6) The use of Doppler ultrasound is useful as it helps to visualize the ureteral jet at the bladder, differentiates the ureters from blood vessels, and can measure the resistive index. A value above 0.70 suggests obstructing hydronephrosis.

A helpful way of ascertaining pathological versus physiological hydronephrosis using ultrasonography is to turn the patient to the contralateral side of the caliectasia, wait 10
to 15 minutes and see if the positional uterine changes helped in clearing the affected urinary pathway. If so, a physiological hydronephrosis is probable. (3)

Transvaginal ultrasound is rarely performed unless doubts arise with the suprapubic ultrasonographic study. It may help to visualize the uretero-pelvic junction and to depict lower gynecological causes.

Albeit ultrasonography being the gold standard, it may be difficult to depict the entire ureter and the obstructed site, making it difficult to distinguish between pathologic and physiologic hydronephrosis. The identification of a distended ureter below the pelvic rim excludes the physiological uterine compression and may imply magnetic resonance imaging (MRI) or less commonly computed tomography (CT). (4, 7) Either CT or MR urography are more accurate than ultrasonography for depicting and differentiating pathological from physiological hydronephrosis (4, 7).

Since ultrasonography is somewhat dependent on patient collaboration during breathing and positional changes and influenced by aerocolia, and MR urography is not always available in some centers, CT may be the only viable options mainly in unstable pregnant women. Unenhanced CT is particularly sensitive to detect radiopaque ureteral stones. According to some authors, it can be performed with relative safety using low doses of radiation. (8) Nevertheless, it is not consensual and most centers keep on using ultrasonography and MR urography as the first choices for a safer study. Contrast-enhanced CT using iodinated agents is not a good alternative since the contrast material passes through the placental barrier exposing the fetus to still uncertain effects.

Although the effects are not clear, preliminary studies show that it is safe to use MR urography, but caution is warranted when performing the exam in magnets higher than 1.5 Tesla. Since it has not ionizing radiation, MR urography use is growing at a steady pace and becoming available in the emergency departments. It has the disadvantage of detecting only 50% of the calculi as filling defects within the lumen, typically appearing as hypointense dots on T2 weighted images. However, it is able to more accurately identify secondary causes of upper tract obstruction. (9)

A particular imaging sign may indicate a distal non-physiological obstruction: the ”double kink". This sign may be elicited by MR urography or CT and it illustrates a small reduction in the diameter of the ureter above the pelvic rim due to compression by the gravid uterus(physiological hydronephrosis) and distally to the pelvic rim a stop sign produced by the pathological obstruction either intrinsic or extrinsic to the ureter.
Fig. 1: 24-year-old female with a gestational age of 13 weeks. Gray-scale ultrasound image (A) at the level of the pelvic rim, showing a physiologic dilatation of the ureter (u) due to uterine compression (f). The site of the extrinsic compression is depicted by the arrow. Color-Doppler (B) better differentiates the ureter dilatation from the external iliac vessels.

References: Department of Radiology, Centro Hospitalar de Lisboa Central, Lisboa, Portugal.

Fig. 2: A 28-year-old female with a 12-week gestation who complained of right side lombar pain. Gray-scale ultrasound images display the right side hydronephrosis in transverse view (A), with a dilated renal pelvis and ureter under the pelvis rim precluding a physiological hydronephrosis. Careful analysis revealed a 5mm distal endoluminal hyperechoic stone, with posterior echo shadowing, near the uretero-vesical junction.

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Fig. 3: 21-year-old female with a 11-week gestation who went to the emergency department with fever and pain eliciting a right Murphy sign. Urinalysis was compatible with urinary tract infection. Ultrasound longitudinal (A, C) and transversal views (B) of the right kidney depict a second degree hydronephrosis. The renal pelvis shows internal echoes in suspension on the dependent portion and wall thickening (A and B calipers), findings that highly suggest pyonephrosis. In the superior pole of the right kidney, a well-defined hyperechoic nodule is found, corresponding to a focal pyelonephritis (arrow).

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Fig. 4: 22-year-old with a 28-week gestational age. Fat-saturated coronal T2 weighted image depicting a physiological hydronephrosis.

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Images for this section:

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Conclusion

The longer it takes to make a diagnosis of hydronephrosis, a higher pain tolerance is achieved and loss of renal parenquima will eventually ensue. So, prompt recognition and medical treatment of non-physiological hydronephrosis in pregnancy prevents renal damage and failure. Ultrasound remains the first choice for quick imaging recognition of hydronephrosis in pregnant women and for the exclusion of other causes besides extrinsic uterine compression.

Personal information

References