

Sonographic evaluation of maternal kidneys in normal pregnancy

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Abstract

Background and objective: Renal disease can affect the outcome of pregnancy. The renal system undergoes significant physiological and anatomical changes during pregnancy. Ultrasound is the commonest imaging modality used in the evaluation of the abdominal organs in pregnancy. The purpose of this study was to sonographically evaluate the kidneys in normal pregnancy.

Methods: A prospective descriptive study in which real time B-mode renal ultrasound was performed on 500 pregnant women attending for a routine obstetric ultrasound scan. Questions about the age, parity and presence of loin pain were asked. Obstetrical ultrasound examination was initially performed followed by examination of maternal kidneys.

Results: Renal collecting system dilatation was the main abnormal finding; it was present in 18.2% of cases, (15.2% right side and 3% left side). Bilateral hydronephrosis was seen in (2.6%) of cases. Rate of hydronephrosis was more in primiparous women. Other findings were renal stones (2.8% right and 1.8% left sides, respectively), ureteric stone (0.2%) and acute pyelonephritis (1%).

Conclusion: This study established the value of renal sonography in the pregnant women, though not a common condition. Renal collecting system dilatation was the main finding. A significant proportion of patients with asymptomatic renal calculi were detected incidentally.

Keywords: Sonography, Maternal kidneys, Normal pregnancy, Hydronephrosis.

Introduction

The renal system undergoes significant physiological and anatomical changes during a normal pregnancy.¹ The occurrence of hydronephrosis and hydroureters during pregnancy has been termed physiological.² The dilatation develops during the second trimester, becomes more prominent on the right side and disappears within a few weeks after birth and is thought to be most pronounced in primigravid females.^{1,3-5} The major risks are infection, renal failure, premature labor, and fetal death.⁶ Acute hydronephrosis or worsening of an existing hydronephrosis has been somewhat overlooked as a possible cause of uncertain abdominal pain during pregnancy. These conditions are examined by means of ultrasonography and treated

by a change in position. In cases of continued pain or affected renal function, the treatment is insertion of a ureteral pigtail catheter.^{7,8} Urolithiasis in pregnancy is rare, but is a significant pathology. Any metabolic effects and the anatomical changes happen in pregnancy can have important role on stone formation.⁹ Approximately 1 per 1500 pregnancies is complicated by urinary calculi. The prevalence of ureteric calculi in pregnancy is low and is estimated around 0.03 - 0.4 % depending on the population.^{1,4} Most pregnant women with renal colic present in the second half of pregnancy with flank pain or hematuria.⁴ Maternal kidney stones are significantly associated with several pregnancy complications.^{10,11} All forms of treatment with the exception of

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extracorporeal shock wave lithotripsy are appropriate in the pregnant patients.¹² Acute pyelonephritis affects 1-2% of pregnant women and this can result in premature labor in 20–30% of women. These premature infants are at high risk of neonatal death in resource-limited settings.¹³ Sonography is typically negative, but findings such as renal enlargement, focal hyperechogenicity, and perinephric fluid may be present.⁴ Maternal renal disease, especially if associated with hypertension, not only adversely affects maternal health and increases fetal morbidity and mortality but may also program the fetus for renal disease and hypertension in adult life.^{14,15} Sonography is the initial imaging study of choice in the evaluation of the kidneys of the pregnant women, in whom ionizing radiation must be kept to a minimum. It can be used at any stage of the pregnancy. It is a relatively inexpensive and versatile technique that is readily available.¹⁶ The aim of this study was to show the role of diagnostic sonography in delineating various renal conditions occurring during pregnancy.

Methods

This is a prospective, descriptive study involving collection of data from daily ultrasound clinic in Erbil city, Kurdistan region of Iraq, from September 2011 till March 2012. The study sample included pregnant women attending routine obstetric ultrasound examination. A sample of 500 pregnant women participated in the study. Data about age, parity and history of lion pain were obtained. No particular attention was paid to the state of the bladder as long as the subjects were felt comfortable and not over-distended. Obstetrical ultrasound was performed for all participants in supine position and then turned to decubitus position for renal examination. The right kidney was scanned first through the left lateral decubitus position by scanning through the posterior axillary line intercostally or subcostally, while the left kidney was scanned through the right

lateral decubitus position by scanning through the posterior axillary line or subcostally. The liver was used as an acoustic window on the right, while the spleen was used on the left. Images of each kidney were obtained in the coronal plane of the kidney, clearly identified as were outlined by the brightlyechogenic renal capsule with a central (sinus) echogenicity, images were frame-frozen and evaluated regarding renal morphology, state of pelvi-calyceal system whether dilated or not, presence of renal or ureteric stones. Degree of hydronephrosis was based on maximum calyceal diameter when ≤ 5 mm indicating no pelvicalyceal dilatation, mild (6–10 mm) moderate (11–15 mm) and severe (>15 mm) sinus echo separation, respectively.¹⁶ A urinary stone can be diagnosed on sonography when there is distinct focal echogenicity with discrete acoustic shadowing.⁴ In suspected cases of pyelonephritis ultrasound findings were supported by laboratory examinations such as general urine examination and urine culture. Real time, B mode, grey scale ultrasound examination was done by using U/S machines (MEDISON, ACCUVIX V20 and GE VOLUSON S8) which were fitted with a 3.5MHz transducer. The study was approved by the Research Ethics Committee of the College of Medicine in Hawler Medical University. Informed consent was obtained from all participants. Statistical package for the social sciences (version 21.0) was used for data entry and analysis. Both descriptive and analytic approaches were used; descriptive to determine the frequencies, mean and standard deviation; and analytic by using Chi-square test to find out associations. A P value ≤ 0.05 was regarded statistically significant.

Results

Of 500 pregnant women, 184 (36.8%) were primigravida and 316 (63.2%) were multigravida; 166 (33.2%) were in their first trimester, 192 (38.4%) in second trimester and 142 (28.4%) in third trimester

pregnancy. The age range of the pregnant women was 15-44 years with mean (\pm SD) of 27.2 ± 5 years. The overall renal conditions detected by sonography were collecting system dilatation (physiological hydronephrosis), renal stones, ureteric stone and pyelonephritis. Physiological hydronephrosis was the main finding (Figure 1). There was a statistically significant association between hydronephrosis

and the gestational ages of the pregnant women as the rate of hydronephrosis (right and left) increased with advancing gestational age ($P = 0.001$ and 0.004 , respectively). Bilateral hydronephrosis was seen in 13 out of 500 pregnant women (2.6%). Hydronephrosis was more common (in primigravida (17.4%) than multigravid women (13.9%) but this difference was not statistically significant (Table1).

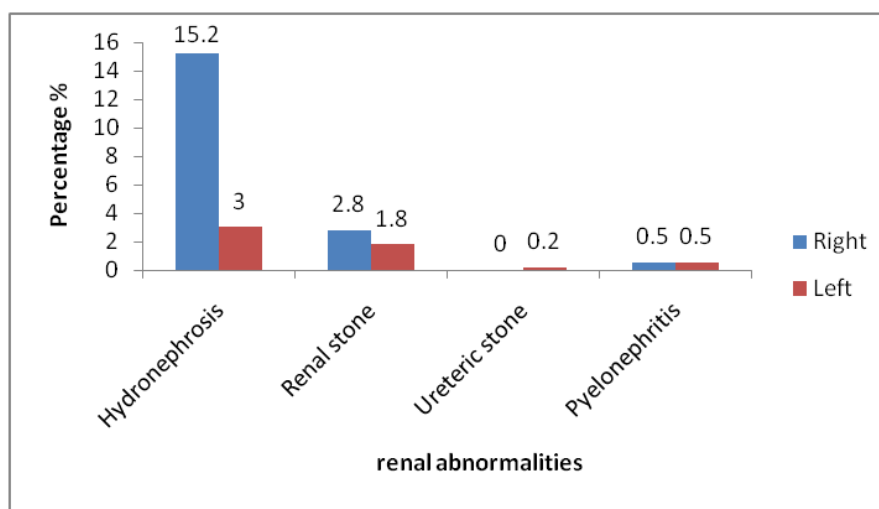


Figure 1: Percentages of abnormal sonographic findings among the studied sample.

Table 1: Association between hydronephrosis with gestational ages and parity.

Variables	No.	Hydronephrosis				Bilateral		
		Right No.	%	Left No.	%	No.	%	
Gestational age	1 st Trimester	166	13	7.8	2	1.2	1	0.6
	2 nd Trimester	192	30	15.6	3	1.6	2	1.0
	3 rd Trimester	142	33	23.2	10	7.0	10	7.0
	Total	500	76	15.2	15	3.0	13	2.6
p			0.001		0.004			
Parity	Multi	316	44	13.9	9	2.8		
	Primi	184	32	17.4	6	3.3		
	Total	500	76	15.2	15	3.0		
p			0.298		0.794			

Significant association was found between renal pain (right and left) and hydronephrosis (right and left) $P < 0.001$ for both (Table 2). Regarding association between trimester of pregnancy and severity of calyceal dilatation or hydronephrosis; there was no significant association between gestational age and the severity

of right side hydronephrosis, while there was a significant association between severity of left side hydronephrosis and gestational ages of the pregnant women, p value-0.031 (Table 3). This study also showed significant association between renal stone (right and left) and renal pain (right and left), $P < 0.001$ for both (Table 4).

Table 2: Association between renal pain and hydronephrosis.

Right Renal pain	Right Hydronephrosis				Total	
	Yes		No		No	%
	No.	%	No.	%		
Yes	67	88.2	9	11.8	76	100
No	75	17.7	349	82.3	424	100
Total	142	28.4	358	71.6	500	100
p	<0.001					
Left Renal pain	Left Hydronephrosis				Total	
	Yes		No		No.	%
	No.	%	No.	%		
Yes	10	66.7	5	33.3	59	100
No	49	10.1	436	89.9	441	100
Total	59	11.8	424	88.2	500	100
p	<0.001					

Table 3: Association between gestational age and severity of hydronephrosis.

Gestational age	Severity of hydronephrosis											
	Right hydronephrosis						Left hydronephrosis					
	Mild		Moderate		Total		Mild		Moderate		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1 st Trimester	11	84.6	2	15.4	13	100	1	50	1	50	2	100
2 nd Trimester	24	80.0	6	20.0	30	100	3	100	0	0.0	3	100
3 rd Trimester	25	75.8	8	24.2	33	100	10	100	0	0.0	10	100
Total	60	78.9	16	21.2	76	100	14	93.3	1	6.7	15	100
p	0.467						0.031					

Table 4: Association between renal stone and renal pain.

Right Renal pain	Right Renal Stone				Total	
	Yes		No		No.	%
	No.	%	No.	%		
Yes	10	7.0	132	93.0	142	100
No	4	1.1	354	98.9	358	100
Total	14	2.8	486	97.2	500	100
p	<0.001					
Left Renal pain	Left Renal stone				Total	
	Yes		No		No.	%
	No.	%	No.	%		
Yes	6	10.2	53	89.8	59	100
No	3	0.7	438	99.3	441	100
Total	9	1.8	491	98.2	500	100
p	<0.001					

Discussion

This study showed that the major abnormal finding was renal collecting system dilatation (hydronephrosis). This develops as a result of compression of the ureter by the gravid uterus and the pelvic brim and progesterone-mediated relaxation of the urinary tract smooth muscle.⁴ There is no information available regarding the maternal hydronephrosis in our population. The overall incidence of hydronephrosis was 15.2% for the right side and 3% for the left side and these figures are very much less than that stated in a literature survey done by Rasmussen and Nielsen.³ Siyal et al¹⁸ evaluated maternal kidneys after 30 weeks gestation and found physiologic hydronephrosis in 64.2% of the examined pregnant women. Regarding right predominance of hydronephrosis in pregnancy, our study is in agreement of several early studies.^{3-6,16,17} The right sided predominance has been attributed to the differences in the anatomical relations of the right and left ureters.^{17,18} Results of no occurrence of hydronephrosis in 424 out of 500 (84.8%) for the right kidney and 485 out of 500 (97%) for the left kidney is higher than detected by Enighe et al¹⁶ that showed 54.3% for the right and 88.6% for the left kidneys in pregnant women. Bilateral hydronephrosis was found in 2.6% of cases and it was more severe on the right side than on the left nearly same as found by Faundes et al.⁵ Though statistically non-significant; this study showed higher rate of gestational hydronephrosis in primigravida women and this is in agreement with other studies.^{1,3,5} Our study showed statistically significant association between renal pain and hydronephrosis both for the right and left sides, right hydronephrosis was seen in 17.7% of asymptomatic pregnant women while The and Chan found 9%.⁶ The present study revealed that hydronephrosis can be seen in either trimester of pregnancy but it was more in occurrence and severity in second and third trimesters. Other studies state that gestational hydronephrosis occur in second

trimester and remain the same in third trimester.^{5,6} All cases of hydronephrosis were either mild or moderate, there were no cases of severe hydronephrosis and this is in agreement with Karabulutet al¹⁷ and Siyal et al.¹⁸ Presence of renal stone in our study was 2.8% for the right kidney and 1.8% for the left kidney and this is higher than that stated by Glanc and Maxwell.⁴ Presence of ureteric stone was 0.2%, which is in agreement with Weerakkody¹ that reported 0.03%-0.4%. A significant proportion of patients with asymptomatic renal calculi were detected incidentally. The potential hazards of intervention (either surgical or medical) and anesthesia need to be considered carefully.⁹ The incidence of acute pyelonephritis was 1%, all in the second trimester. This is in agreement with Sharma and Thapa¹⁹ that found 1.3% and Bajwa et al²⁰ that found 1-2%.

Conclusion

The method of ultrasonography used in the assessment of maternal kidneys was easy, non-invasive and reliable one. Given the close proximity of the urinary system to the uterus and adnexa, it is not surprising that renal examination can result in the discovery of incidental findings. Renal collecting system dilatation was the major finding detected by ultrasound and it was more on the right side.

Conflicts of interest

The author reports no conflicts of interest.

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