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Magnetic Resonance Imaging in the Detection of Renal Stones During Pregnancy

Dr. Firas Salah Hameed [1]***, Dr. Omar Khaleel Ibrahim*** [2] ***and Dr. Salam Salah Hameed*** [3]

[1]*M.B.Ch.B., F.I.C.M.S. \ (Diagnostic Radiology) (Specialist Radiologist) Iraqi Ministry of Health, Diyala Health Directorate, Baqubah Teaching Hospital, Diyala, Iraq.*

[2]*M.B.Ch.B., F.I.C.M.S., C.A.B.M.S. \ (Urology) Iraqi Ministry of Health, Diyala Health Directorate, Baqubah Teaching Hospital, Diyala, Iraq.*

[3]*M.B.Ch.B., F.I.C.M.S. \ (Urology) (Specialist Urologist) Iraqi Ministry of Health, Diyala Health Directorate, Baqubah Teaching Hospital, Diyala, Iraq.*

Abstract: Background: Kidney stone disease is the most common urinary system disorder. Kidney stones is uncommon during pregnancy. Exhibiting complications like pyelonephritis and MRI is useful. Aim: This study specialized to evaluate clinical outcomes of renal stones during pregnancy, which are detected using MRI. Patients and methods: 85 pregnant women with kidney stones were enrolled. Patient data were collected from different hospitals in Iraq between February 2023 and March 2024. All pregnant patients underwent early diagnosis by magnetic resonance imaging: obstetric outcomes and clinical complications of the pregnant women after delivery were recorded. Results: Based to our study's outcomes, we found 78.82% of pregnant women get Calcium Phosphate stones; 62.35% of women have Stones sizes < 10 mm; stone intensity detected by MRI with 130 - 200 of 74.12% for women, maternal and neonatal complications got 45 cases, where 5 cases of maternal and 4 cases of neonatal were dead. Conclusion: MRI technique, which is accurate of differentiating physiological urinary tract dilatation to abnormal dilatation due to renal stones and through detecting complications, including pyelonephritis.

Keywords: Magnetic resonance imaging (MRI), Renal stones, and Pregnant women.

INTRODUCTION

Nephrolithiasis, or kidney stones, is uncommon during pregnancy. According to estimates, the incidence of symptomatic cases can reach 1 in 2000 pregnancies, and the rate is comparable for both pregnant and non-pregnant women (Khaling Mikawlrawng, K. M *et al*., 2014; EL-Sheikh, H. E *et al*., 2022; Sigurjonsdottir, V. K *et al*., 2015). The most common non-obstetric cause of pregnancy-related belly pain and consequent hospitalization is renal colic. The presence of the fetus and the physio-anatomical alterations in the urinary system may make the clinical presentation, as well as subsequent treatment of nephrolithiasis, more difficult (Rule, A. D *et al*., 2010; Taylor, E. N *et al*., 2005; Courbebaisse, M *et al*., 2016).

Anatomical changes specifically include the action to progesterone upon the ureteral smooth muscle and the dilation that occurs in the renal calyces, pelvis, along with ureters as a result of the pregnant uterus being compressed (Kumar, S. B. N *et al*., 2012; Rao, P. N., 2014; ELBAHNASY, A. M *et al*., 1998; PBoulay, I., 1999). Increased renal plasma flow along with glomerular filtration rate are among the physiological alterations that result in hypercalciuria and hyperuricosuria (Kalb, B *et al*., 2010; Renard-Penna, R *et al*., 2015). Throughout the late second and initial third trimesters in pregnancy, these physio-anatomical alterations cause hydronephrosis and urine stasis, which are more prevalent on the right side and might resemble pathologic situations like genuine hydronephrosis (Sudah, M *et al*., 2011).

(Shamir, S. B *et al*., 2020)A powerful and adaptable imaging technology, magnetic resonance imaging (MRI), may provide more diagnostic data than any other method. Cost, acquisition time, and sensitivity to patient mobility are the primary negatives. Although several studies have demonstrated that MRI might be utilized to diagnose a wide variety of underlying abdominal and pelvic illnesses in pregnant women having acute abdominal or as pelvic discomfort, MRI is still not always accessible in the emergency environment (Regan, F *et al*., 2005; Kirpalani, A *et al*., 2005).

METHODS

We conducted a cross-sectional study of 85 pregnant women patients aged 20–35 years during the period from February 2023 to March 2024 in different hospitals in Iraq. All women were diagnosed by magnetic resonance imaging. The quality of life of pregnant patients during the diagnosis period and after delivery to ensure women's health was analyzed and evaluated by a questionnaire conducted on all women, which largely covered the effect of magnetic resonance imaging in the early detection of kidney stones in pregnant women. All data and results for pregnant women were collected by the SPSS program, 22.0. As for the inclusion and exclusion criteria for

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***Corresponding Author:** Dr. Firas Salah Hameed

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pregnant women, 1) women aged 20-35 years, 2) women who underwent magnetic resonance imaging, 3) women who had obesity, and 4) smokers and non-smokers were included. 1) Women with previous surgeries; 2) Women with severe anemia or hypothyroidism; 3) Women with CT scans; 4) Women aged less than 20 and older than 35 were excluded. A general diagnosis was made for pregnant women, as the data identified symptoms that were most prevalent in pregnant patients. In addition, the types, sizes, and density of kidney stones were also detected by MRI.

The patient was getting ready for an MRI In order to guarantee proper hydration as well as a full bladder, patients were advised to drink water half an hour prior to search. For those who had a catheter, the urethral catheter had been dilated one hour prior to the examination.

A 1.5 Tesla MR scan was performed on each individual. The following method was used to do an in-depth examination on the whole abdomen, from the diaphragm through the pubic bone: Matrix = 177 256; resolution = 1.4 1.4 millimeters2; slice thickness = 6 millimeters; flip angle = 150°; echo train length = 256; echo time = 84 milliseconds; repetition time = 1200 ms; the number of averages = 1; and readout bandwidth = 362 Hz/pixel were the imaging settings used to produce the images using an MRI scanner.

The kidney stone's size and signal strength have been determined and identified. The findings of the same patient's interpretation MRI were compared to determine whether or not the kidney stone was actually discovered. In terms of precisely assessing the size of stones, they were also contrasted.

RESULTS

Table 1. Distribution of clinical features on all patients.

Categories	Variables	Participants, (n = 85)	Percentage, %
Age, years			
	20 – 25	30	35.29%
	26 – 30	40	47.06%
	31 – 35	15	17.65%
Body mass index{kg/m2}			
	Normal weight	20	23.53%
	Overweight	38	44.71%
	Obese	27	31.76%
Smoking status			
	Present	15	17.65%
	Absent	70	82.35%
Comorbidities		14	16.47%
	No	71	83.53%
	Hypertension	4	4.71%
	Asthma	1	1.18%
	Hyperlipidemia	7	8.24%
	Others	2	2.35%
ASA classification			
	I	22	25.88%
	II	43	50.59%
	IV	20	23.53%
Diet types			
	Good	63	74.12%
	Poor	22	25.88%
Education level			
	Primary	9	10.59%
	Secondary	27	31.76%
	University/postgraduate	49	57.65%
Socioeconomic status			
	Low	16	18.82%

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	Middle	55	64.71%
	High	14	16.47%

Table 2: Distribution of symptoms on all patients observed in this study.

Symptoms	Frequency, 85	Percentage, %
Flank Pain	66	77.65%
Renal Colic	70	82.35%
Haematuria	10	11.76%
Fever	68	80%
Urinary tract infections	34	40%

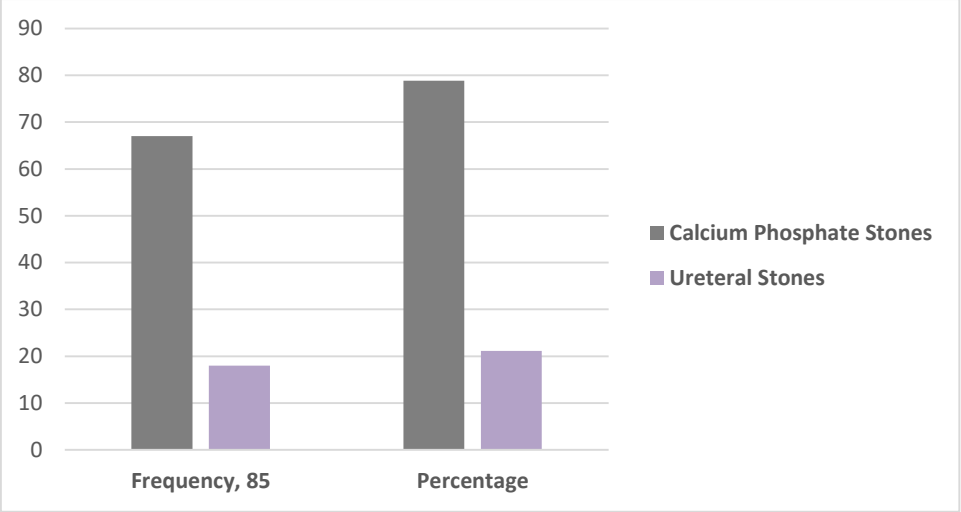

Figure 1: Categorizing types of renal stones in pregnant women.

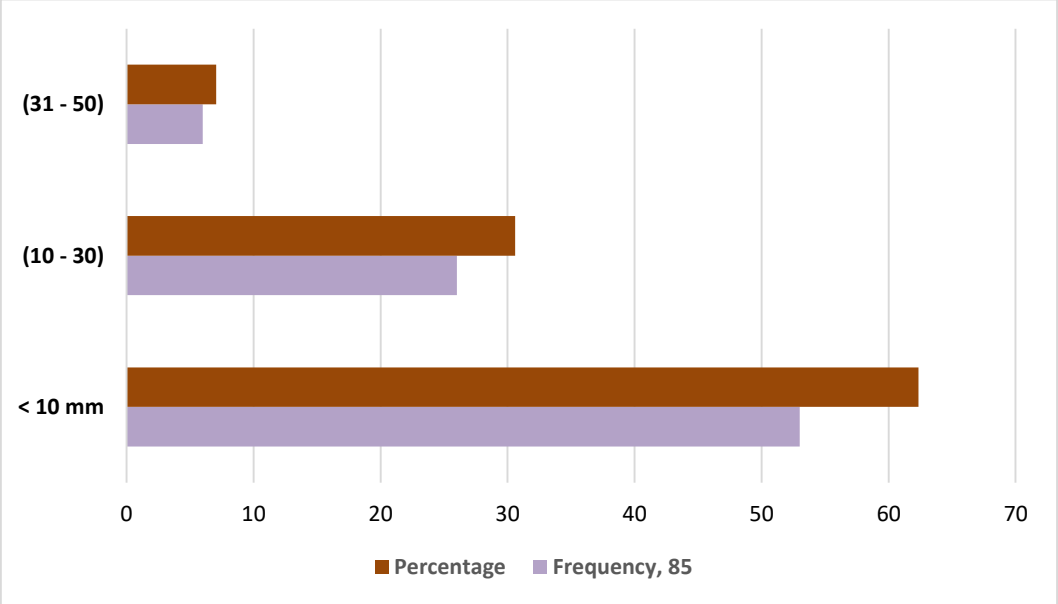

Figure 2: Determining stone size detected by MRI.

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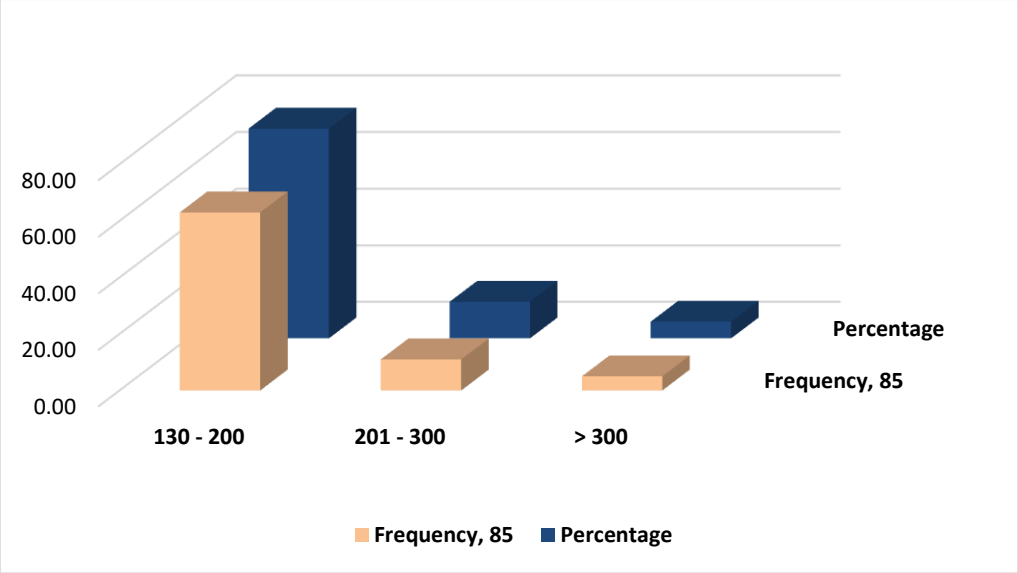

Figure 3: Distribution of stone intensity by MRI within all patients.

Table 2: Obstetric outcomes of women with kidney stones detected by MRI.

Variables	Frequency, (85)	%
Gestational age, weeks		
< 37	24	28.24%
37 - 40	57	67.06%
> 40	4	4.71%
Birth weight (Kg)		
< 1.5	20	23.53%
1.5 - 2.5	52	61.18%
> 2.5	13	15.29%
Mode of delivery		
Cesarean section	29	34.12%
Vaginal delivery	56	65.88%
Number of pregnancies		
0	42	49.41%
1	35	41.18%
> 1	8	9.41%
Type of pregnancy		
Singleton	81	95.29%
Twin	4	4.71%

Table 3: Adverse outcomes.

Variables	Frequency, 85	%
Maternal		
Preeclampsia	12	14.12%
Increased surgical interventions	5	5.88%
Urinary tract infections	4	4.71%
Bleeding	2	2.35%
Death	5	5.88%
Neonatal		
Preterm Birth	13	15.29%
Death	4	4.71%
Total	45	52.94%

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DISCUSSION

The size of the stone determines the extent of an impact MRI has in enabling the identification of stones. The concept that calculi cannot be detected on MRI scans was refuted by some research. There are no evidence of the rocks in the T1- and T2-weighted sequence signal. Urinary tract diseases can be identified by employing T2-weighted sequences to quickly detect perirenal high-intensity signals, occlusion, as well as blockage. Ureteral dilatation is frequently used to detect blockage-related ureteral calculi (Lifshitz, D. A., & Lingeman, J. E., 2002; Akpinar, H *et al*., 2006).

Furthermore, additional studies (Rana, A. M *et al*., 2009; Semins, M. J *et al*., 2009) found that renal calculi less than 1 cm are rarely noticeable but can become plainly visible if they are larger than 1 cm in diameter. Sensitivity also rises with calculus size. The level of sensitivity for renal stones can be increased due to hydronephrosis, which increases the amount of urine surrounding the calculus.
MRI was used to diagnose uretero-hydronephrosis with 90% sensitivity and 100% specificity. The study found that for specific filling deficiencies like calculus, the specificity and sensitivity reached 68 and 84 percent, respectively (Yamazaki, J. N., & Schull, W. J., 1990). Even though MRI has a limited sensitivity for detecting small renal stones, it can reveal indirect effects of a clogged urinary system.

MRI, or magnetic resonance imaging, has been used extensively to study both acute flank pain and urinary obstruction. When it comes to detecting perirenal fluid being an early sign of acute ureteric obstruction brought on by stone illness, MRI is superior (Castronovo Jr, F. P., 1999; Brent, R. L., 1989).

Urinary stones can be detected on MRI as a signal void in the collecting system, according to an American study (Wagner, L. K *et al*., 1997). Larger stones (greater than 1 cm) and the existence of surrounding significant intensity urine, which is often present within obstructed collecting systems, make it easier to see the stones with MR (Barnett, S. B., 2002; Abramowicz, J. S *et al*., 2003).

CONCLUSION

Urologists, obstetricians, and radiologists have to collaborate together to treat nephrolithiasis during pregnancy. Making a diagnosis early is crucial. When evaluating study and therapy choices, the patient's and the growing fetus's health comes first. MRI is capable of recognizing problems like pyelonephritis and distinguishing between normal urinary tract dilatation and aberrant dilatation linked to renal stones. MRI is still a valid method for showing kidney stones in expectant mothers.

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