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ORIGINAL PAPER

Maternal hydronephrosis in pregnant women without ureteral stones and characteristics of symptomatic cases who need treatment: A single-center prospective study with 1026 pregnant women

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Summary

Purpose: *The aim of this study is to determine the proportion of maternal hydronephrosis and symptomatic cases requiring treatment in pregnant women without ureteral stones and the characteristics of these cases.*

Materials and methods: *Between February 2018 and April 2019, all pregnant women followed for pregnancy in obstetrics and outpatient policlinic were evaluated prospectively. Maternal hydronephrosis rate, degree of hydronephrosis and side, symptomatic hydronephrosis rate, maximum renal anteroposterior diameter of renal pelvis and visual analogue scale were detected. Symptomatic patients were treated conservatively or surgically. Findings in both treatment groups were analyzed by t-test or Chi-squared test. Pearson or Spermean's tests were used for correlation analyzes.*

Results: *A total of 1026 pregnant women aged 18-45 (27.7 ± 5.2 years) were followed prospectively. The rate of maternal hydronephrosis was 28.7% and the rate of symptomatic hydronephrosis was 4.7%. Of the patients with symptomatic hydronephrosis, 73.4% (3.5% of total) were treated conservatively and 26.5% (1.3% of total) were treated surgically. There was a positive correlation between hydronephrosis and gestational week ($p < 0.001$), visual analogue scale ($p < 0.001$) and hematuria ($p < 0.05$). There was a negative correlation between hydronephrosis and maternal age ($p < 0.05$) and number of pregnancies ($p < 0,001$). The anteroposterior diameter of renal pelvis ($p < 0.001$), visual analogue scale ($p < 0.05$) and fetal body weight values ($p < 0.05$) on the right side were higher in the surgical treatment group than the conservative group.*

Conclusions: *The majority of cases with maternal hydronephrosis in pregnant women without ureteral stones are asymptomatic. Most symptomatic cases can also be treated conservatively. In cases requiring surgical treatment (1.3%), fetal body weight, visual analogue scale and anteroposterior renal pelvis diameter are higher.*

KEY WORDS: *Hydronephrosis; Pregnancy; Maternal; Symptomatic; Treatment.*

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INTRODUCTION

Asymptomatic maternal hydronephrosis during pregnancy may be present in more than 90% of pregnant women (1-3). Therefore, maternal hydronephrosis due to pregnancy is generally considered a normal -physiological- phenomenon. However, there are also cases of maternal hydronephrosis that require treatment.

Therefore, maternal pathological obstructive hydronephrosis cases should be differentiated from maternal physiological dilatations. For this purpose, some authors suggest the use of the term "*physiological maternal renal pelvic dilatation*" to avoid the pathological connotations of the term maternal hydronephrosis (4).

According to the literature, the rate of symptomatic maternal hydronephrosis is 0.2-3% (1, 5-10). Untreated cases of symptomatic maternal hydronephrosis can cause fulminant pyelonephritis and urosepsis in the presence of urinary infections (9). Therefore, it should not be late in the treatment of symptomatic hydronephrosis cases.

Otherwise, it may cause urosepsis, which may endanger the life of both mother and fetus (5, 11-13). In addition, acute antepartal pyelonephritis significantly increases preterm birth (13, 14).

Maternal upper urinary tract dilatations, which are considered physiologically normal, are mostly observed on the right side. It usually develops after the mid-gestation (4, 15-19). Urinary dilatation in pregnant women is explained by the effect of progesterone on the smooth muscle of the urinary system and the compression of the expanding uterus into the ureter (2, 4, 18, 20). Further observation of dilatations on the right side and twin pregnancies also supports this hypothesis (4). In addition, the crossing of the ureter by the ovarian vein at the pelvic brim on the right while running parallel on the left, dextrorotation of the uterus, and the relative protection of the left ureter provided by the sigmoid colon are also possible factors (2, 4, 18). As a matter of fact, maternal hydronephrosis usually improves spontaneously after delivery because the compression of the uterus is removed after birth (19, 20). And a few weeks after birth completely disappeared (15, 18, 20).

The first-line imaging test to diagnose maternal hydronephrosis is *ultrasonography* (US) (21, 22).

No conflict of interest declared.

Because US is a non-invasive and ionizing radiation-free imaging technique (21).

In addition, maternal nephrosonography findings during pregnancy were quantitatively and qualitatively documented years ago (15, 16). Ultrasonographic evaluation has been the mainstay of obstetric imaging for many years (4). Maternal hydronephrosis can be detected with abdominal US from the beginning of the second trimester of pregnancy (23). US is excellent for the detection of hydronephrosis. However, there may be some problems in distinguishing between pregnancy-dependent physiological hydronephrosis and stone-dependent obstructive hydronephrosis. In fact, according to literature data, the success of conventional gray-scale US in detecting obstruction due to ureteral stones is 77-80%, as it cannot detect stones in the middle ureter usually (24). *Magnetic resonance imaging* (MRI) technique may be preferred in these patients (22). But the first step of the imaging method that should be preferred during pregnancy is US (21, 23).

For detection of maternal renal dilatations, intrarenal calyceal dilatations or *anteroposterior renal pelvis diameter* (APD) are measured by US (4, 25, 26). The most common measurement for diagnosis and classification is APD. But it gives limited information in terms of prognostic. Because although APD is an objective, non-invasive and easily detectable measurement, it cannot show parenchymal changes and the true degree level of hydronephrosis (26).

Treatment options for symptomatic maternal hydronephrosis are conservative treatment and surgery (1, 5).

Conservative treatment includes close monitoring, analgesic, intravenous fluid and, if necessary, antibiotics.

Surgical treatment includes double pigtail (JJ) ureteral stent insertion and percutaneous nephrostomy. And it is usually applied in severe flank pain that does not respond to medical treatment and in the presence of severe hydronephrosis (1, 5). However, it is not yet clear which treatment approach should be chosen for patients with symptomatic maternal hydronephrosis (1).

Our aim in this study was to determine the proportion of maternal hydronephrosis and symptomatic cases requiring treatment in pregnant women without ureteral stones and the characteristics of these cases.

Materials and methods

A prospective controlled study was designed. The study protocol was approved by the institutional ethics committee of the *School of Medicine, Istanbul Medipol University, Turkey* (15/02/2018-604.01.01-E.5443).

Between February 2018 and April 2019, maternal renal ultrasonography was performed in all pregnant women followed up in the outpatient clinic of Gynecology and Obstetrics in our university(at least one ultrasonographic measurement in the first, second and third trimester and 2-3 months after birth). The presence and absence of hydronephrosis, if any, degree and side or it were noted. The maximum renal anteroposterior diameter of renal pelvis (APD) was measured in patients with hydronephrosis. Serum glucose, *blood urea nitrogen* (BUN), creatinine, *white blood cell count* (WBC), *C-reactive protein* (CRP), urine analysis(presence of hematuria and leukocyturia) and urine culture-antibiogram were detected. Maternal age (year), gestational age (week), *body mass index* (BMI), number of pregnancies, number of fetuses, arterial blood pressure, *amniotic fluid index* (AFI), birth week, type of delivery, birth sex, *baby weight* (FBW) and 5. minutes Apgar score was recorded.

Symptomatic patients were treated conservatively or surgically. Findings in both treatment groups were analyzed statistically.

All ultrasonographic investigations and renal pelvis measurements were performed by radiologists and registered obstetricians who were trained in ultrasonograpy with experience ranging 7 to 25 years, using a LOGIC P6 PRO ultrasonography system with a 3.5 MHz broadband curvey array transducer (*GE Healthcare, Gyeonggi, Korea*).

The *visual analogue scale* (VAS) was used to determine severity of the flank pain (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; 0 and 10 points as no pain and maximum pain, respectively) (28).

Hydronephrosis was classified according to a common grading system, and definitions followed the guidelines of the *European Association of Urology* (Grade 0, no renal pelvis dilation; Grade 1, mild renal pelvis dilation (anteroposterior diameter less than 10 mm) without dilation of the calyces nor parenchymal atrophy; Grade 2, moderate renal pelvis dilation (between 10 and 15 mm), including a few calyces; Grade 3, Renal pelvis dilation with all calyces uniformly dilated, normal renal parenchyma; Grade 4, as grade 3 but with thinning of the renal parenchyma, represents mild parenchymal loss; Grade 5, severe parenchymal loss (28).

All hydronephrosis cases with flank pain (VAS > 2), fever and leukocyturia and/or leukocytosis were considered symptomatic.

All symptomatic patients with hydronephrosis were referred to the Urology outpatient clinic and treated medically or surgically according to clinical and laboratory findings. First, position, analgesic and intravenous fluid treatment were applied in the medical treatment group. In patients with signs of infection such as fever, leukocytosis and elevation of CRP, Sefamezin was started if the antibiogram result was negative. If the antibiogram result was positive, antibiotic was determined according to antibiogram.

The following cases were defined as the failure of medical treatment; 1) The infection findings do not improve within 48 hours despite antibiotic treatment, 2) Distortion of renal functions, 3) Increased flank pain, or no decrease in flank pain.

The patients with at least one of these findings and all patients with hydronephrosis grade 3 were treated surgically by double-J ureteral stent insertion. For this, 6-8 Fr double-J ureteral stent (*Boston Scientific, MA, USA*) was inserted under local or general anesthesia with cystoscopic guidance to the side of hydronephrosis. In all cases, the hospitalization course and the complications of surgery were recorded. The stent was monitored ultrasound and it was removed one month after delivery.

The data obtained were classified and analyzed statistically. Statistical analyses were performed using NCSS statistical software (*Number Cruncher Statistical System,*

	N	Mean ± SD %
Age (years)		27.7 ± 5.2
Gestational age (weeks)		24.5 ± 8.5
Number of pregnancy		1.7 ± 1.0
Number of primipara women	516	50.2%
Number of multiple pregnancy	8	0.7%
Hydronephrosis side;		
Right	295	28.7%
Left	27	2.6%
Bilateral	27	2.6%
Trimester;		
1 (< 14th weeks)	108	10.5%
2 (14th-27 weeks)	489	47.6%
3 (27th-41 weeks)	429	41.8%
Hydronephrosis;		
No (Grade 0)	731	71.2%
Hydronephrosis	295	28.7%
Grade 1	183	17.8%
Grade 2	92	8.9%
Grade 3	20	1.9%
Treatment;	49	4.7%
Conservative	36	3.5%
Surgical	13	1.2%
Total	1.026	100%

Table 1.
Patient characteristics of 1.026 pregnant women.

2007, Kaysville, Utah, USA). Descriptive statistics (mean ± SD and percentages) were used to present demographic information of the study participants. Discrete data are presented as numbers (N) and percentages (%). ANOVA test, t test and Chi square test were used for statistical analysis (when appropriate); P values less than 0.05 were considered statistically significant.

This study was carried out with 1.026 pregnant women who met the inclusion criteria. Power calculation was performed. All proportional and parametric comparisons in subgroups are at least 95% power.

Inclusion criteria

Pregnant women followed in the obstetrics clinic.

Exclusion criteria

Renal tract calculi, structural renal parenchymal or collecting system anomalies (single kidney, horseshoe kidney, renal ectopia, duplicated collecting system, ectopic ureter, and extra renal pelvis), previous surgical intervention to the kidneys or ureters, and renal malignancy. Renal tract calculi was detected mainly by ultrasonography. However, MRI was performed in cases whose ureteral stones could not be completely excluded by ultrasonography, especially in middle ureteral stones.

Results

A total of 1.026 pregnant women aged between 18 and 45 years (27.7 ± 5.2) were followed during the study period. The number of cases with hydronephrosis was 295 (28.7%). The mean age of the patients with hydronephrosis was 27.1 ± 4.6 (18-43 years). Hydronephrosis was on the right side in 295 patients (28.7%) and on the left side in 27 patients (2.6%). The number of patients with bilateral hydronephrosis was 27 (2.6%). Of the 295 pregnant women with hydronephrosis, 246 (83.3%) were asymptomatic. Of the 49 patients (16.6%) with hydronephrosis, 36 (73.4%) were treated conservatively and 13 (26.5%) were treated surgically (Table 1).

There was a positive correlation between hydronephrosis and gestational week ($p < 0.001$), VAS score ($p < 0.001$) and hematuria ($p < 0.05$). There was a negative correlation between hydronephrosis and maternal age ($p < 0.05$) and number of pregnancies ($p < 0.001$).

There was no positive or negative correlation between maternal hydronephrosis and BMI, number of fetuses, glucose, BUN, creatinine, WBC, CRP, arterial blood pressure, leukocyturia, AFI, birth week, delivery type, FBW and Apgar score ($p > 0.05$) (Table 2).

While leukocituria was positive in 28 of the symptomatic cases (57.1%), only 17 of these cases were culture posi-

Table 2.
Patient characteristics and clinical data.

	Hydronephrosis N (%), Mean ± SD				
	Grade 0	Grade 1	Grade 2	Grade 3	
Age (years)	27.9 ± 5.3	27.2 ± 4.5	26.6 ± 4.7	27.9 ± 5.2	r = -0.070. p = 0.024
BMI	26.7 ± 4.6	27.1 ± 5.1	26.2 ± 3.3	31.9 ± 6.2	r = -0.021. p = 0.507
GA (weeks)	23.3 ± 8.6	26.8 ± 6.8	28.7 ± 5.8	29.7 ± 6.9	r = 0.233. p = 0.000
GA at delivery	38.7 ± 1.2	38.8 ± 0.9	38.9 ± 0.8	39.2 ± 0.9	r = 0.091. p = 0.293
Number of pregnancy	1.86 ± 1.1	1.68 ± 1.0	1.43 ± 0.7	1.75 ± 0.8	r = -0.128. p = 0.000
Multiple pregnancy	5 (0.68%)	1 (0.54%)	2 (2.1%)	0 (0%)	r = 0.016. p = 0.616
Glucose	84.3 ± 12.6	85.5 ± 12	82.8 ± 10.3	84.3 ± 11.2	r = 0.068. p = 0.459
Serum BUN (mg/dl)	9.2 ± 2.2	10.3 ± 2.3	9.7 ± 2.7	10.4 ± 3.2	r = 0.170. p = 0.617
Creatinine (mg/dl)	0.46 ± 0.13	0.43 ± 0.2	0.38 ± 0.2	0.42 ± 0.3	r = -0.102. p = 0.408
WBC (x103 µl)	9.2 ± 2.3	9.5 ± 2.0	16.3 ± 9.3	17.4 ± 7.2	r = 0.165. p = 0.055
CRP (mg/dl)	5.0 ± 2.3	6.1 ± 2.6	7.4 ± 2.5	9.7 ± 2.9	r = 0.297. p = 0.149
Apgar score. 5-min	9.7 ± 0.4	9.7 ± 0.4	9.5 ± 0.6	9.9 ± 0.2	r = 0.095. p = 0.225
FBW (kg)	3.37 ± 0.4	3.27 ± 0.3	3.30 ± 0.2	3.59 ± 0.4	r = -0.028. p = 0.755
VAS score	0	3.3 ± 1.7	3.1 ± 1.9	6.2 ± 2.1	r = 0.382. p = 0.000
TA (mm/Hg);					
Systolic	107.6 ± 12.4	107.9 ± 10.2	109.9 ± 12.7	107 ± 6.3	r = 0.018. p = 0.581
Diastolic	65.2 ± 9.3	64.6 ± 8.2	66.6 ± 9.2	63 ± 8.5	r = 0.007. p = 0.816
Primipara	341 (46.6%)	104 (56.8%)	63 (68.4%)	11 (55%)	r = 0.016. p = 0.616
Hematuria	23 (3.1%)	39 (21.3%)	44 (47.8%)	14 (70%)	r = 0.244. p = 0.013
Leukocyturia	27 (3.7%)	48 (26.2%)	47 (51%)	13 (65%)	r = -0.068. p = 0.570
AFI;					
Normal	720 (98.4%)	176 (96.1%)	89 (96.7%)	19 (95%)	r = -0.32. p = 0.320
Polyhydramnios	12 (1.64%)	7 (3.8%)	2 (2.1%)	1 (5%)	
Oligohydramnios	1 (0.13%)	0 (0%)	1 (1.1%)	0 (0%)	
Trimester;					r = 0.213. p = 0.000
1 (< 14th weeks)	101 (13.8%)	7 (3.8%)	0 (0%)	0 (0%)	
2 (14th-27 weeks)	356 (48.7%)	83 (45.3%)	46 (50%)	4 (20%)	
3 (27th-41 weeks)	274 (37.4%)	93 (50.8%)	46 (50%)	16 (80%)	
Treatment;	0 (0%)	11 (6.0%)	18 (19.5%)	20 (%100)	r = 0.133. p = 0.648
Conservative	0 (0%)	10 (5.4%)	16 (17.3%)	10 (50%)	
Surgical	0 (0%)	1 (0.5%)	2 (2.1%)	10 (50%)	
Participants	731 (71.2%)	183 (62%)	92 (31.1%)	20 (6.7%)	
Total	731 (71.2%)		295 (28.7%)		1.026 (100%)

GA, gestational age; BUN, blood urea nitrogen; WBC, White blood cells count; CRP, C- reactive protein; FBW, fetal body weight; VAS, visual analogue scala; TA, tension arterial, AFI, Amniotic fluid index; APD, anteroposterior diameter of renal pelvis.

Table 3.
Patient characteristic and clinical data in treatment groups.

	Conservative (n = 36)	Surgical (n = 13)	P value
Age (years)	26.8 ± 4.4	28.9 ± 4.5	p = 0.1492
Body mass index (BMI)	29.7 ± 5.4	27 ± 4.2	p = 0.1099
Gestational age (weeks)	28.2 ± 6.6	30 ± 5.3	p = 0.3813
Gestational age at delivery	38.7 ± 0.7	39.4 ± 0.9	p = 0.0063
Cesarean section rate	24 (66.6%)	8 (61.5%)	p = 0.7432
Fetal body weight (kg)	3.36 ± 0.32	3.61 ± 0.37	p = 0.0310
Apgar score. 5-min	9.8 ± 0.2	9.9 ± 0.2	p = 0.0923
Primipara	25 (69.4%)	7 (53.8%)	p = 0.3163
Tension arterial (mm/Hg);			
Systolic	106 ± 7	107 ± 6	p = 0.6496
Diastolic	62 ± 8	66 ± 5	p = 0.0993
Visual analogue scala	3.1 ± 1.9	5.2 ± 1.9	p = 0.0013
Serum blood urea nitrogen (mg/dl)	11.9 ± 3.3	12.4 ± 3.7	p = 0.6522
Creatinine (mg/dl)	0.71 ± 0.3	0.72 ± 0.3	p = 0.9184
White blood cells count (x103µl)	12.2 ± 3.3	13.5 ± 3.4	p = 0.2331
C-reactive protein (mg/dl)	11.7 ± 13	17.3 ± 15	p = 0.2074
Hospitalization (day)	4.7 ± 2.6	4.1 ± 3.4	p = 0.5149
Culture positive rate	13 (36.6%)	4 (30%)	p = 0.6718
Anteroposterior diameter of renal pelvis (mm);			
Right	15.7 ± 5.1	27.9 ± 9.6	p<0.0001
Left	2.7 ± 1.9	4.3 ± 3.7	p = 0.0526
Amniotic fluid index (AFI);			
Normal	35 (97.2%)	13 (100%)	p = 0.5463
Polyhydramnios	1 (1.9%)	0 (0%)	p = 0.6203
Oligohydramnios	0	0	
Trimester;			
1 (< 14th weeks)	0	0	
2 (14th-27 weeks)	15 (41.6%)	3 (23%)	p = 0.2378
3 (27th-40 weeks)	21 (58.3%)	10 (77%)	p = 0.2354

tive (34.6%). *Sefamesin* was used in 20 of these symptomatic cases, *Nitrofurantoin* in 5 and *Ceftriaxon* in 3 of these patients (according to antibiogram). No infection was observed without clinical response. There was no patient who developed sepsis or who did not respond clinically to these anitibiotic treatments. Almost all of the pregnant women with hydronephrosis were in the second and third trimester. In the third trimester, there were 155 (52.5%) hydronephrosis (grade 1; 93 (60%), grade 2; 46 (29.6%) grade 3; 16 (10.3%).

In the second trimester, there was 133 (45%) hydronephrosis (grade 1; 83 (62%); grade 2; 46 (34.4%), grade 3; 4 (3%). The number of hydronephrosis in the first trimester was only 7 (2.3%), all of which were grade 1. Of the 49 patients treated due to hydronephrosis, 18 (36.7%) were in the second trimester and 31 (63.2%) were in the third trimester.

The maximum APD on the right side of the patients in the surgical treatment group was significantly higher than the conservative group (27.9 ± 9.6 mm-15.7 ± 5.1 mm, p < 0.0001). Similarly, the VAS values were significantly higher in the surgical treatment group (5.2 ± 1.9-3.1 ± 1.9; p = 0.0013). FBW values were also higher in the surgical treatment group than the conservative treatment group (3.61 ± 0.37-3.36 ± 0.32; p = 0.031). There was no significant difference between the two treatment groups in terms of other parameters (Table 3).

Double-J stent was easily inserted in all patients and successful responses were obtained in the surgical treatment group. Two of the patients in the surgical group (15.3%) complained of stent discomfort and flank pain. But no infection, stent migration, or fragmentation were observed. No invasive procedure such as percutaneous nephrostomy was required in any patient. The mean duration of stent insertion was 4.7 ± 1.2 months.

Three months after delivery, no hydronephrosis was observed in any patient.

Discussion

Our results in this study partially confirm the literature data. Some of our findings contradict the literature. In fact, while the rate of maternal hydronephrosis reported in the literature is up to 80-90% (1-4), the maternal hydronephrosis rate in our study is 28.7%. There may be two possible causes of this discrepancy. First, we used the common grading system for the detection and classification of hydronephrosis (28), not the maximal APD. However, most of the studies in the literature have used the maximal APD for hydronephrosis classification.

However, although the APD value seems to be an objective measurement, it cannot show the true grade of hydronephrosis (26). The results also vary according to the criteria for hydronephrosis. As a matter of fact, maternal hydronephrosis rate was 21% according to a study in which APD value of 10 mm and above was accepted as hydronephrosis (29).

The second, we have also accepted exclusion criteria for some diseases that may cause urinary obstruction such as renal tract calculi, structural renal parenchymal or collecting system anomalies (single kidney, horseshoe kidney, renal ectopia, duplicated collecting system, ectopic ureter, and extra renal pelvis), previous surgical intervention to the kidneys or ureters. This may have reduced our rates of hydronephrosis.

Maternal hydronephrosis, which are considered physiologically normal, are mostly observed on the right side and usually develop after mid-gestation (4, 15-19). Our findings also confirm these data in the literature.

However, while the rate of symptomatic maternal hydronephrosis reported in the literature is 0.2-3% (1, 2, 8-10), the rate of symptomatic hydronephrosis in our study is 4.7%.

In other words, this ratio is relatively high compared to the literature average. However, the rate of semptomatic cases that need surgical treatment is 1.2%. This ratio coincides with the literature data.

We observed a significant relationship between the degree of hydronephrosis and flank pain/VAS score. However, there are different data in the literature. For example, *Farr et al.* (27) evaluated that the association between maternal hydronephrosis and acute flank pain during pregnancy in a prospective pilot-study and reported that there is no clear association between the grade of maternal hydronephrosis and pain intensity, which complicates diagnostic assessment.

In addition, *Watson and Brost* examined 81 pregnant

women and observed that there was no association between flank pain and hydronephrosis (29).

Another finding that does not coincide with the literature data is the correlation between multiple pregnancies and hydronephrosis. According to the literature, more maternal hydronephrosis is observed in twin pregnancies (4). But we could not confirm this finding. Because the number of multiple pregnancies in our study was only 8 (0.7%) and it was not statistically sufficient to determine the positive correlation between maternal hydronephrosis and multiple pregnancies.

Most of the pregnant women with maternal hydronephrosis in this study were asymptomatic (83.3%). In addition, a large proportion of symptomatic cases (73.4%) were treated conservatively.

The number of cases requiring surgical treatment was only 1.2%. Our findings are consistent with the literature. Because the proportion of patients with symptomatic maternal hydronephrosis, which can be treated conservatively, is approximately 70-80%, some of which are reported as high as 96% (1, 2, 5).

Symptomatic maternal hydronephrosis during pregnancy can be treated conservatively, especially in the presence of mild hydronephrosis. And also maternal-perinatal results are excellent. However, some cases may be resistant to conservative treatment. Surgical treatment should be considered for these cases, especially if severe hydronephrosis is present (1, 2, 5). Because symptomatic hydronephrosis may cause premature birth or maternal-fetal death when left untreated (13).

Treatment method of symptomatic hydronephrosis in pregnancy is still unclear (1). According to the literature, approximately 70-80% of the pregnant women with symptomatic hydronephrosis can be treated with conservative approach. For the remaining 20-30%, additional treatments are required (1, 13). However, one of the high DJ stent insertion rate (72%) in the literature was published, and additionally, 4% of patients underwent percutaneous nephrostomy (1, 11). For this reason, the optimal treatment option in pregnant women with symptomatic hydronephrosis is unclear (1, 9).

Fainaru et al. (2) reported that 73% of patients with maternal hydronephrosis had mild hydronephrosis and that they responded perfectly to conservative treatment in terms of maternal-perinatal outcomes, but that 7.1% of symptomatic patients with moderate or severe hydronephrosis did not respond to conservative treatment.

Tsai et al. (5) reported 80% of patients with maternal hydronephrosis responding to conservative treatment during pregnancy and 0.27% of moderate to severe symptomatic maternal hydronephrosis.

The response to conservative treatment reported in the literature is up to 96% (2, 5, 9). So, the authors reported that they obtained a lower rate of response to conservative treatment than the literature because they excluded patients with mild hydronephrosis from the study and included only patients with moderate to severe hydronephrosis (5). However, this rate reported by them is actually consistent with the literature. Because according to the literature, the rate of patients who respond to conservative treatment is about 70-80% (13). On the other hand, there are studies reporting higher rates of surgical treatment. In fact, *Ercil et al.* (1) reported the treatment data of a total of 211 patients with symptomatic maternal hydronephrosis, of which 131 (62%) were conservatively treated and 80 (38%) were treated surgically. According to the authors, the high number of patients treated surgically (ie, double-J stent insertion) was related to the purpose of referring patients to the hospital. Because all patients were referred from another center and especially for surgical treatment. In addition to this, the presence of urinary tract infections is quite high due to our patient profile which is composed of patients with low socioeconomic level and poor hygienic conditions. In case a high level of antibiotic resistance due to unconscious antibiotic use is added, conservative approach was failed in these patients and surgical intervention was required (1).

Double-J ureteral stent insertion is effective in the management of symptomatic hydronephrosis (5, 8, 19). Early or late complications of ureteral stents may occur if the stent is left for more than three months. However, the morbidity of pigtail stent insertion is minimal if the stent is left for less than three months (5). But some series reported the early and late complications of double pigtail ureteral stents. Early complications include patient discomfort, irritative bladder symptom, bacteriuria with or without urinary tract infection, urosepsis, hematuria, or flank pain, and later complications are upward or downward stent migration, calcification, and fragmentation (5, 12). As a matter of fact, in also this study, double-j stent were successfully inserted and removed in all patients in the surgical treatment group. There was no early or later serious complications in any patient. Only two patients (15.3%) complained of stent discomfort and flank pain. But no urosepsis, stent migration, calcification or fragmentation were observed.

Another issue discussed for the treatment of maternal hydronephrosis is whether there are any parameters that can be used to determine the optimal treatment option. *Ercil et al.* (1) reported that CRP, WBC and VAS levels were higher in the surgical treatment group, which increased the likelihood of surgical treatment, thus high CRP and WBC levels seemed to be a predictor for surgical treatment.

In our study, VAS scores was higher in the surgical treatment group. But we did not observe such a significant difference between the two groups in terms of CRP and WBC levels.

There are also literature data supporting our findings. Generally, CRP levels are used to assess treatment response rather than predicting treatment in patients with symptomatic hydronephrosis (1, 5, 9).

In a prospective randomized trial, *Tsai et al.* (5) also found no significant difference in WBC, BUN, creatinine levels between the conservative and surgical treatment groups. But, in *Ercil et al's* study (1), no statistically significant difference was found by researchers between the treatment groups in terms of BUN and creatinine levels, whereas WBC level was found to be statistically higher for surgical treatment group than the conservative treatment group in both trimester. As the writers say, the main reasons of this difference may be the number of

patients or the fact that their study group is composed of more complicated patients, especially the higher number of patients with urinary infection (1). However, in pregnant women with flank or low back pain, the presence of obstruction due to urinary tract infection should also be considered, and if appropriate, these infections should be treated appropriately (1, 10-13, 27).
Some limitations of this study should be taken into account. Although the number of pregnant women who were followed prospectively was adequate, the number of multiple pregnancies which could be correlated with maternal hydronephrosis was low. Because risk pregnancies including multiple pregnancies, are mostly followed in the central hospital of our university. However, the pregnant women who were followed in the central hospital of our university were not included in this study.
Therefore, we could not determine the correlation between maternal hydronephrosis and multiple pregnancies. Hence, our cohort might not reflect an overall obstetric population in terms of the number of multiple pregnancies.

Conclusions

Most cases of maternal hydronephrosis in pregnant women without ureteral stones are asymptomatic. Also, a significant part of symptomatic cases can be treated conservatively. However, some of the cases require surgical treatment(double-J ureteral stent insertion).
For this reason, maternal hydronephrosis cannot be described as a completely physiological phenomenon. In cases requiring surgical treatment, fetal body weight, visual analogue scale and anterior-posterior renal pelvis diameter were higher than asymptomatic cases.

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