Comparison of percutaneous nephrostomy and double J stent in symptomatic pregnancy hydronephrosis treatment

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Background/aim: We aimed to compare the success rate of percutaneous nephrostomy (PCN) and double J stenting (DJS) in the treatment of symptomatic pregnancy hydronephrosis.

Materials and methods: Diagnosis and grading of hydronephrosis were performed by urinary ultrasound (USG) and Doppler mode was used for evaluation of renal arterial resistivity index (RI). Patients were divided into two groups according to the method used for the treatment of hydronephrosis: group A (PCN, n = 38) and group B (DJS, n = 46). A P value < 0.05 was considered significant.

Results: The number of patients requiring second intervention was higher in group B (P = 0.0018) and time to secondary intervention was significantly earlier in group B also (P = 0.0025). The number of tertiary intervention was again higher in group B (5/16 vs. 1/6) and the need for tertiary intervention was higher in patients who underwent DJS implantation as a secondary intervention than those who underwent PCN (5/11 vs. 1/11, P = 0.0012). The time to tertiary intervention was longer in patients with PCN than in those with DJS (P = 0.0048).

Conclusion: PCN may be preferred to DJS in symptomatic pregnancy hydronephrosis because it requires fewer re-interventions after longer times.

Key words: Percutaneous nephrostomy, hydronephrosis, ureteral catheters, pregnancy

1. Introduction
Pregnancy is a process causing significant anatomical and physiological changes in all organ systems. The urinary system is among the systems exposed to these changes during pregnancy and hydroureteronephrosis is the most significant of them. An average increase of 50%–70% in renal blood flow and 30%–50% increase in glomerular filtration rate occur during pregnancy. Intense exposure to progesterone induces decreased peristalsis in the ureter smooth muscle and dilating of the ureters. Typically, hydronephrosis begins at 6 to 10 weeks of gestation and occurs in 90% of pregnant women in the last trimester (1). Hydronephrosis that occurs in the early stages of pregnancy is associated with increased progesterone. In later stages of the pregnancy, the ureteral pressure of the growing uterus and physiological dilation of the right ovarian vein are the main reasons for hydronephrosis (2).

This pressure effect is monitored on the right side 2–3 times more than on the left side (3). On the left side, the existence of the sigmoid colon prevents the compression of the ureter (4). These changes in ureters usually resolve within 4–6 weeks after birth.

The most common nonobstetric indication for hospitalization during pregnancy is abdominal or flank pain (5). It is fundamental for the clinician to determine whether the pain is originating from the urinary system, to distinguish between physiologic and pathological dilation if the pain is originating from the urinary system, and finally to determine the most appropriate treatment method if the dilation is pathological. Conservative treatment methods are primarily preferred in pregnancy hydronephrosis unless invasive methods are mandatory. If there is no amelioration of symptoms despite a conservative approach, interventional treatments such as ureteral catheterization and percutaneous nephrostomy (PCN) may be required. Both PCN and double J stenting (DJS) are widely used methods to alleviate hydronephrosis in pregnancy (6,7).

Symptomatic hydronephrosis is a urological emergency as it may cause premature labor and should be alleviated as quickly as possible. In this retrospective study, we aimed to compare the PCN and DJS outcomes in our pregnant patients who did not respond to conservative treatment and had symptomatic hydronephrosis. To the best of our knowledge, this is the
first study comparing these two methods in the treatment of pregnancy hydronephrosis.

2. Materials and methods
This retrospective study was conducted in the urology clinic of a third step university hospital. The data of pregnant patients who underwent PCN and DJS between January 2000 and December 2016 were collected from the patient files. The study was conducted in compliance with the Declaration of Helsinki.

2.1. Patient selection
A total of 84 patients were included in the study. Urinary ultrasonography (USG) was performed for diagnosis and grading of hydronephrosis; renal USG was performed in Doppler mode for assessment of renal arterial resistivity index (RI). The hydronephrosis grading was done according to the grading system of the Society of Fetal Ultrasound (SFU) and the renal arterial RI was calculated using the “peak systolic velocity – end diastolic velocity / peak systolic velocity” formula. Urinary USG was performed by different physicians, but a physician experienced in urological radiology supervised all applications. Patients were divided into two groups according to the method used for the treatment of hydronephrosis: group A (PCN, n = 38) and group B (DJS, n = 46). Only patients who were thought to have hydronephrosis due to pregnancy were included in the study. A total of 14 patients with ureteral stones (n = 6), ureteropelvic junction stenosis (n = 4), and ureteropelvic junction stones (n = 4) were excluded from the study. The PCN or DJS was implanted according to the preference of the patients. In those without a preference, the intervention was performed according to the preference of both the surgeon and the patients. If the patient did not have a preference about the intervention method, a decision was made based on some predictive factors. PCN application is preferred if hydronephrosis grade is high in USG, echogenic particles appear pointing to infected urine, patient is at high risk for anesthesia, and the patient is in early gestational weeks. However, if these findings are not present, DJS is preferred, especially if the patient is in the third trimester and the risk of anesthesia is not high. Data of the patients were analyzed according to the applied methods in terms of success of hydronephrosis relief and the necessity and time of re-interventions.

2.2. Operation and intervention techniques
DJS implementation was performed under general anesthesia. Informed, written consent of the patients was obtained before the procedure. The patients consulted with the gynecology clinic prior to the operation and their approval was received for the operation. Sterile urine was provided by all patients before the surgery. One gram of cefazolin was administered intravenously with anesthesia induction. In lithotomy position, a 22 Fr endoscope (Karl Storz, Germany) was introduced into the urethral meatus. After the ureteral orifice was visualized, a 6 Fr open-ended ureter catheter was gently passed 1–2 cm through the ureterovesical orifice. A sensor PTFE-Nitinol Guidewire (Boston Scientific) was passed through the open-ended catheter. After being sure that the sensor was in the renal collecting system with a single shot of the fluoroscopy, a 6 Fr DJS (26 cm, 0.035”, silicone based, Elit Medikal) was placed in the collecting system by sliding over the sensor.

PCN implementations were also performed by the urology clinic. Informed, written consent of the patients was obtained before the procedure. Patients were repositioned on the opposite side of the kidney to receive the intervention. The intervention planned access tract and the calyx were determined with USG. Five milligrams of lidocaine was injected into the access tract. After 10 min, the access was performed with a nephrostomy needle into the planned calyx with the guidance of USG. A guide-wire was passed from the needle into the collecting system and after dilation of the tract with serial dilators a 8 Fr nephrostomy tube (Boston Scientific) was implanted. After the urine output was seen through the tube, it was fixed to the skin with 2/0 silk sutures.

2.3. Data collection
The demographic data of patients, gestational week, and intervention method were collected from patient files. Hydronephrosis status in control USG, recurrence rate, and number of re-intervention methods were recorded.

2.4. Outcome measures
Our primary outcome measures were postintervention hydronephrosis status and recurrence rate and number. The secondary outcome was the comparison of the rate and number of recurrences and the success rate of the two methods in relieving hydronephrosis between the groups.

2.5. Statistical analysis
The normal distribution of the data was checked by Kolmogorov–Smirnov test. Pearson's correlation analysis and Spearman rank and Mann–Whitney U-tests were used for analysis of the variables. A two-tailed P value less than 0.05 was considered statistically significant. Multivariate analysis was performed for the variables with statistically significant results in the correlation analysis. All analyses were performed using SPSS 23.0 for Macintosh.

3. Results
Over the last 16 years, a total of 84 pregnant patients required intervention for symptomatic hydronephrosis in our clinic. PCN was performed in 38 patients (group A) and DJS was performed in 46 patients (group B). Demographic data and gestational weeks of the patients were similar between the two groups as shown in Table 1.
A total of 22 patients required a second intervention. Six of them were in group A and 16 were in group B. The second intervention was required 33 days after the first procedure in the first group and 18 days in the second group, respectively. PCN and DJS were implemented in three patients each in the first group and eight patients each in the second group. A third intervention was required after 10 days in one of the 3 DJS-implanted patients in the first group, after 16 days in one of the 8 PCN-implanted patients, and after 8 days in the fourth of 8 DJS patients in the second group. The third intervention was necessary in a total of 6 patients. The reasons for the third intervention were dislocation of the stent caudally in 2, increase in the grade of hydronephrosis associated with encrustation in 1, and duration of the periodic replacement in 2 of 11 patients with DJS. The third intervention was required in 1 of 8 patients with PCN due to dislocation of the tube. Thirty-one patients in the first group and 25 patients in the second group did not require re-intervention. The study flow diagram is shown in the Figure.

There was a significant difference between the groups in terms of the need for secondary intervention (15.7% vs. 34.7%, P = 0.0018). The time to secondary intervention was significantly shorter in the DJS group than in the PCN group (18 vs. 33 days, P = 0.0025). The reasons for the secondary intervention were the increased hydronephrosis grades and pain of the patients depending on the dislocation or encrustation of the PCN or DJS. In group A, 4 patients had an increase in hydronephrosis grade despite the nephrostomy tube and the tube dislocated in 2 patients. In group B, 6 patients had an increase in hydronephrosis grade due to DJS encrustation, 6 patients had DJS dislocations, and 4 patients needed stent replacement due to febrile urinary tract infection. In the second group, the number of patients requiring tertiary intervention was higher than in the first group (5/16 vs. 1/6) and the need for tertiary intervention was higher in patients who underwent DJS implantation as a secondary intervention than in those who underwent PCN (5/11 vs. 1/11, P = 0.0012). The time to tertiary intervention was 10 days in the DJS group in the first group, and 16 days in the PCN group and 8 days in the DJS group in the second group (P = 0.0048). Table 2 shows re-intervention rate, type, and time.

4. Discussion
While asymptomatic hydronephrosis is seen in 90% of pregnancies (8,9), the incidence of symptomatic hydronephrosis in the literature varies by 0.2%–3% (10). If symptomatic hydronephrosis is left untreated, it may cause premature labor and maternal or fetal death (11). Therefore, it is very important to distinguish symptomatic hydronephrosis in pregnancy and to provide appropriate treatment. Approximately 70%–80% of patients with symptomatic hydronephrosis are treated conservatively, while the remaining 20%–30% require invasive treatments (11). Some predictive factors anticipating the success of the intervention are also important in the choice of invasive procedures, besides patient and physician preference. As noted above, hydronephrosis grade, gestational week, risk of anesthesia and comorbidities of the patient, urine appearance in the USG image, and other associated pathologies of the urinary tract are the main factors. On the other hand, the European Association of Urology guidelines suggest that PCN and DJS, two methods used for emergency treatment of hydronephrosis, are equally effective (12,13). These two methods are also frequently used in pregnancy. However, a study comparing the results of these two methods in pregnancy has not been conducted yet.
Due to high exposure to the hormone progesterone in pregnancy, ureter peristalsis decreases and the ureter becomes dilated. Therefore, it may be easier to perform ureteroscopy in pregnancy and to indwell a stent (14). However, severely disturbing symptoms such as dysuria, flank and suprapubic pain, and urgency may occur due to the stent. Ringel et al. reported that 32% of stents had to be removed before the scheduled time due to their side effects (15). With the developing technology, devices used in urology have also been improved; thinner and flexible ureteroscopes, laser lithotriptors, and new design basket forceps have been developed. With these devices and safe anesthesia methods stone treatment in pregnancy has been performed more conveniently in recent years (16). Tsai et al. analyzed conservative and surgical management for symptomatic moderate and severe hydronephrosis in pregnancy. Fifty patients were included in the study; 25 of them were followed conservatively and 25 underwent DJS implantation. The DJS group showed a lower failure rate than the group receiving conservative treatment (P = 0.018) but 16% of patients had stent-related discomfort and flank pain. They concluded that conservative treatment should be the first option because of the discomfort caused by surgical treatment although DJS is an effective treatment modality for moderate to severe symptomatic hydronephrosis (17).

Figure. Study flow diagram.
The risk of stent calcification is high because of changes in electrolyte balance in pregnancy. Goldfarb et al. presented a case of accelerated incrustation due to the hypercalciiuric situation in pregnancy and emphasized the need for hydration, calcium restriction, and close monitoring to prevent infection and stone formation in pregnancy (18). Peer et al. have pointed out the risk of technical difficulties of stent application, anesthesia requirement, and inducing birth, and reported that pain and pyonephrosis were successfully treated with percutaneous nephrostomy in their patients and pregnancy continued uneventfully until birth with preservation of renal function (19). The application of PCN by local anesthesia may provide a significant advantage, especially in the pregnant patient subgroup. In cases where the nephrostomy tube needs to be replaced, general anesthesia can be prevented in these patients and the fetus can be protected from the potential side effects of anesthesia.

Tschada et al. evaluated the outcome of internal urinary diversion in complicated pregnancy hydronephrosis and found that complications were seen in 11 of 14 patients and obstruction was relieved in only 6 patients after long-term follow-up. They concluded that internal drainage should be well evaluated in complicated pregnancy hydronephrosis (20). Several studies have shown that DJS is an effective and safe method for symptomatic pregnancy hydronephrosis treatment (6,7,21,22). However, most of these studies are small case-group and noncomparative studies. Conservative and surgical treatment outcomes for pregnancy hydronephrosis have also been compared in many studies (17,23,24). These studies have demonstrated that DJS is an effective and safe method for the treatment of pregnancy hydronephrosis. Percutaneous nephrostomy has been performed in a small number of cases in a few studies and successful results have been reported (19,24–26). Most recently, Khoo et al. assessed the short-term complications and success rate of percutaneous nephrostomy during pregnancy (27). Eight patients successfully underwent nephrostomy and sepsis occurred in 1 patient. They pointed out acceptable technical and clinical results of percutaneous nephrostomy during pregnancy, but these studies were also retrospective, small case-group, and noncomparative studies.

The predictive value of RI in pregnancy hydronephrosis has been analyzed to give a decision about intervention. Bodakci et al. enrolled 27 pregnant patients with unilateral symptomatic persistent hydronephrosis (group 1) and 38 pregnant patients with physiological hydronephrosis of pregnancy (group 2). Renal Doppler USG was performed to detect RI and Delta RI (the difference between the RI of the corresponding and contralateral kidney) of all pregnant patients. The mean renal RI of the hydronephrosis side was 0.68 ± 0.05 in group 1 and 0.60 ± 0.05 in group 2 (P < 0.001). The mean delta RI of group 1 was significantly higher than the mean delta RI of group 2 (0.07 ± 0.03 versus 0.02 ± 0.01, respectively, P < 0.001). They concluded that the delta RI was more provocative than RI in order to determine the intervention in pregnancy hydronephrosis (28). Atar et al. also evaluated Doppler USG in the management of symptomatic pregnancy hydronephrosis. They found higher RI values for kidneys with ureteric obstruction than contralateral normal kidneys and they treated these patients with semirigid URS (29). In our study, the RI values of both groups were higher than 0.60 (0.68 and 0.64), which was generally accepted as the threshold value, but there was no significant difference between the groups (P = 0.455). Hydronephrosis in pregnancy is common in the second and third trimesters.

Table 2. Data of the patients in terms of re-intervention rate, type, and time.

<table>
<thead>
<tr>
<th>Variablesa</th>
<th>PCN group</th>
<th>DJS group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cases</td>
<td>38</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>Secondary intervention</td>
<td>6 / 15.7%</td>
<td>16 / 34.7%</td>
<td>0.0018</td>
</tr>
<tr>
<td>Secondary intervention time (day)</td>
<td>33</td>
<td>18</td>
<td>0.0025</td>
</tr>
<tr>
<td>Secondary intervention method</td>
<td>PCN</td>
<td>DJS</td>
<td>PCN</td>
</tr>
<tr>
<td>Number of cases</td>
<td>3</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Tertiary intervention</td>
<td>None</td>
<td>1 / 33.3%</td>
<td>1 / 12.5%</td>
</tr>
<tr>
<td>Tertiary intervention time (day)</td>
<td>10</td>
<td>16</td>
<td>8</td>
</tr>
</tbody>
</table>

a Values are given as number or percentage
b Percutaneous nephrostomy
c Double J stent
and usually becomes symptomatic during this time (30). Symptoms mostly initiated and intervention was required in our patients at the end of the second trimester and at the beginning of the third trimester in accordance with this knowledge. In our study, the rate of both second and third intervention in the DJS group was higher than in the PCN group. The time that elapsed until the second and third interventions was longer for the patients that underwent PCN. Although DJS and PCN are equally effective for urgent decompression of the collecting system, we found that this is not the case for pregnant patients. There may be many reasons for this situation: different encrustation rates depending on the structures of the inserted catheters, different biochemical and hormonal characteristics of patients, and physiological ureter dilatation. We have not conducted an analysis of these factors and this is one of the shortcomings of our study. We decided to question the quality of life of the patients with the EuroQol EQ-5D form, but we gave up because this form did not have validity for our language. As we have already mentioned, physiological ureter dilatation is a well-known phenomenon in pregnant women with the influence of hormonal and mechanical factors, and we attribute the frequent dislocation of the stents to this situation. Other shortcomings of our study include the small number of cases and the retrospective nature. More consistent results may be obtained with prospective, randomized trials with more cases involving the detailed stent and patient factors discussed above.

We concluded that PCN is more effective and feasible than DJS in symptomatic pregnancy hydronephrosis treatment, because patients with PCN require less re-intervention and their re-intervention time is longer. On the grounds that many factors may affect this situation, our results need to be verified with prospective studies including more patients and analyzing more variables.

References


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