

The Maximum Anteroposterior Diameter of Renal Pelvis Changes by Hydration in Cases of Ureteropelvic Junction Obstruction

Üreteropelvik Bileşke Darlıklı Olgularda Renal Pelvisin Maksimum Anteroposterior Çapı Hidrasyonla Değişir

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ABSTRACT Objective: The aim of this study is to investigate the degree of variation of hydronephrosis by hydration in patients with ureteropelvic junction obstruction (UPJO). **Material and Methods:** Patients with antenatally diagnosed UPJO who admitted in a three months period were evaluated in terms of variation in sonographic findings for hydronephrosis. Serial renal ultrasounds were carried out before and after hydration considering parameters for hydronephrosis. Parameters evaluated on each ultrasound included degree of hydronephrosis, maximum anteroposterior diameter of the renal pelvis (mAPD) and anteroposterior pelvic diameter at hilum (hAPD), renal parenchymal thickness, dimensions of both kidneys, grade of hydronephrosis and the volume of the bladder. **Results:** Eleven children with unilateral hydronephrosis due to UPJO were evaluated. There were 10 males and 1 female at a mean age of 10.3 (3-30) months. The mean value of mAPD before hydration was 19.3±4.3 and increased to 21.3±4.6 mm (9.6% increase) after hydration showing a statistically significant difference (p=0.006). The corresponding measurements for hAPD before and after hydration were 14.5±3.6 mm and 14.6±3.4 mm respectively (p=0.846). Parenchymal thickness before and after hydration were 7.2±0.53 and 6.9±0.44 respectively which also showed no statistical significance (p=0.335). Hydration was found to have no significant effect on the parameters examined of contralateral kidney. **Conclusion:** The commonly used ultrasonographic parameters in the follow-up examination of hydronephrotic kidneys are prone to hydration effects. Among these parameters hAPD seems to be less affected.

Key Words: Hydronephrosis; ultrasonography

ÖZET Amaç: Bu çalışmanın amacı üreteropelvik darlıklı çocuklarda hidrasyon sonucu oluşan hidronefrozda meydana gelen değişikliklerin ortaya konulmasıdır. **Gereç ve Yöntemler:** Üç aylık bir dönem içinde kliniğimize başvuran antenatal tanı üreteropelvik bileşke darlığı hastaları hidronefrozun ultrasonografik parametrelerindeki değişim açısından değerlendirilmiştir. Bu değerlendirme, hidrasyon öncesi ve sonrasında değişik parametreleri kapsayan tekrarlayan ultrasonografiler ile yapılmıştır. Her çalışmada böbrek boyutları, hidronefrozun derecesi, renal pelvis maksimum anteroposterior çapı (mAPD), renal pelvisin hilus düzeyindeki anteroposterior çapı (hAPD), hidronefrozun derecesi, böbreklerin parankim kalınlıkları ve mesane hacmi değerlendirilmiştir. **Bulgular:** Bu çalışmada üreteropelvik bileşke darlığı olan 11 çocuk değerlendirilmiştir. Grup 10 erkek ve 1 kız hastadan oluşmaktadır. Ortalama yaş 10,3 (3-30) aydır. mAPD için hidrasyon öncesi ortalama değer 19,3±4,3 mm iken, hidrasyon sonrası 21,3±4,6 mm'e yükselmiştir, gruplar arasında anlamlı fark saptanmıştır (%9,6 artış) (p=0,006). Eş zamanlı hAPD'deki ölçümler ise hidrasyon öncesinde 14,5±3,6 mm, sonrasında 14,6±3,4 mm şeklinde saptanmıştır, gruplar arasında istatistiksel açıdan anlamlı fark yoktur (p=0,846). Hidrasyon öncesi parankim kalınlığı 7,2±0,53 iken, beslenme sonrası 6,9±0,44'tür, gruplar arasında istatistiksel açıdan anlamlı fark yoktur. Hidrasyonun karşı taraf böbrekle ilgili parametreler üzerine anlamlı bir etkisi gözlenmemiştir. **Sonuç:** Üreteropelvik bileşke darlığı olan olgularda hidronefrozun derecesini değerlendirmede kullanılan ultrasonografik ölçütler hidrasyona bağlı değişiklikler göstermektedir. Bu ölçütler içerisinde hAPD daha az etkilenen bir parametre olarak görülmektedir.

Anahtar Kelimeler: Hidronefroz; ultrasonografi

Ultrasonography is approved to be the principle imaging modality in the evaluation of urinary tract for providing valuable detailed information and being non-invasive. It is considered as the primary investigation for detecting congenital anomalies and also displays an important aspect of many follow-up protocols. It gains great importance especially in situations like ureteropelvic junction obstruction (UPJO) where close follow-up is needed to consider whether surgery is essential or conservative management can be sustained.

A significant increase in hydronephrosis and deterioration in function are currently the most common indications for surgical treatment in UPJO.¹ Kidney sizes, grading system of Society for Fetal Urology (SFU), parenchymal thickness and anteroposterior diameter of pelvis are frequently used parameters evaluated to define degree of hydronephrosis.² Measurement of anteroposterior pelvic diameter (APD) serves as a well-defined comparable parameter, and reviewing our results revealed that it was mostly the alerter parameter for surgery in our patients.

Therefore, despite the known augmenting effect of hydration on the hydronephrotic renal pelvis, reliability of APD in the decision making process of these patients deserves attention.³⁻⁶ The aim of this study was to evaluate the variability of APD with hydration in patients with UPJO.

MATERIAL AND METHODS

This study was designed as a cross-sectional one including patients with antenatally diagnosed unilateral hydronephrosis who admitted to our clinic in a three months period (June–August 2009). Patients with vesicoureteral reflux or ureteral dilatation were excluded from the study. All patients had former ultrasonographies, voiding cystourethrographies and MAG3 renograms. Patients with vesicoureteric reflux or ureteral dilatation were not included in the study. Furthermore, patients having completely extrarenal or intrarenal located hydronephrotic pelvises were excluded due to their

potential of different behavior in case of hydration, which may be quite unique and diverse from the majority.

To investigate the variations in sonographic parameters due to hydration; at least six studies were performed for each patient. The caregiver was instructed to feed just as *at home* and inform one of the investigators when she plans to feed the child. Feeding volume and time were noted for the bottle-fed, and the duration of lactation and time were noted for the breast-fed children. Serial ultrasound studies were carried out just before and 30 minutes after the completion of oral feeding. All ultrasound studies were performed by one physician (M.A.) using a SSI-600 scanner (SonoScape Co., Shenzhen, China) with a 3.5 or 6.5MHz transducer in the same room. The transducer that allowed best visualization of the kidney in the transverse plane was chosen. All measurements were documented in the image files and reviewed by one radiologist (S.S.O.) using these image files.

Parameters evaluated on each examination included maximum APD of the renal pelvis (mAPD) and APD of the renal pelvis at hilum (hAPD), renal parenchymal thickness, dimensions of both kidneys, and the volume of the bladder. Each kidney was evaluated at its mid-coronal and mid-transverse sonographic sections. During mid-coronal scanning, parenchymal thickness was measured as the distance between outer border of the dilated calices and the surface of kidney. The bladder volume was noted at the beginning of all examinations. While the patients were lying supine, their flanks were scanned to obtain the mid-transverse section of each kidney displaying renal pelvis at its largest anteroposterior diameter, at which mAPD and hAPD were measured. Using the largest transverse section of the pelvis, mAPD was measured as the widest distance in anteroposterior plane of the kidney. In the same section, hAPD was accepted as the distance between the two edges of the hilum in its maximum width (Figure 1). Images were also evaluated according to the SFU grading system.

This study constructed according to the ethical principles of Helsinki declaration, 2008 and written consent was obtained from the families. Statistical

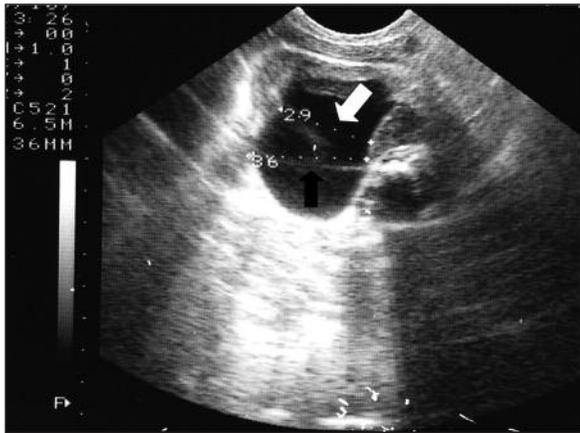


FIGURE 1: Mid-renal transverse image of the kidney. Black arrow indicate the maximum AP pelvic diameter and white arrow indicate the renal pelvis AP diameter at hilum.

analyses of the pre-hydration and post-hydration sonographic measurements were performed using SPSS (v.16.0) by repeated measurements ANOVA test for comparisons. A p value of less than 0.05 was considered to indicate a significant difference.

RESULTS

This study included eleven children with unilateral hydronephrosis due to UPJO. The whole group consisted of 10 males and 1 female at a mean age of 10.3 (3-30) months. Four of these patients later scheduled for surgery due to progressive hydronephrosis in 3 and loss of function in one.

Six patients had grade 2, two patients grade 3, and three patients had grade 4 hydronephrosis. Six to ten measurements per patient were performed.

The mean value of mAPD before hydration was 19.3±4.3 mm and increased to 21.3±4.6 mm (9.6% increase) after hydration showing a statistically significant difference (p=0.006). The corresponding measurements for hAPD before and after

hydration were 14.5±3.6 mm and 14.6±3.4 mm respectively. The measurements demonstrated no significant increase in hAPD following hydration (p=0.846). Parenchymal thickness before and after hydration were 7.2±0.53 and 6.9±0.44 respectively which also showed no statistical significance (p=0.335) (Table 1). Kidney sizes and APD values of the contralateral kidney demonstrated no change with hydration (Table 2). Feeding volumes were variable and our group was too small to evaluate a relation between the amount of feeding and change in hydronephrosis; however, repetitive measurements dividing the group as before and after feeding for each patient showed no significant variation (Table 3). The bladder volume was not also found to have a correlation with hydration status or the diameter of the renal pelvis (mean bladder volume 31.03 mL before and 24.43 mL after hydration, p=0.229).

TABLE 1: Mean values of main measurements of hydronephrotic kidney before and after hydration.

	Before	After	Difference	
	Hydration	Hydration	%	p
mAPD	19.3±3.6	21.3±4.6	9.6	0.006
hAPD	14.5±3.6	14.6±3.4	0.6	0.846
Paranchymal thickness	7.2±0.53	6.9±0.44	4.3	0.335

TABLE 2: Mean values of main measurements of contralateral kidney before and after hydration.

	Before	After	Difference	
	Hydration	Hydration	%	p
mAPD	3.28±0.48	3.36±0.38	2.3	0.534
hAPD	2.89±0.38	2.91±0.45	0.6	0.660
Paranchymal thickness	9.56±0.86	9.54±1.26	0.2	0.872

TABLE 3: Mean values of repetitive measurements of hydronephrotic kidney.

	First Measurement	Second Measurement	Third Measurement	p
mAPD before hydration	19.61	18.53	19.62	0.408
hAPD before hydration	13.69	14.53	14.84	0.599
mAPD after hydration	21.46	21.61	22.53	0.553
hAPD after hydration	14.46	14.23	15.38	0.680

DISCUSSION

Ureteropelvic junction obstruction is the most common cause of antenatally detected hydronephrosis occupying a great deal of practice for pediatric urologists and radiologists. Majority of hydronephrosis due to UPJO improves and even resolves spontaneously; therefore, current tendency is towards nonsurgical treatment. Observation of these patients consists of serial ultrasound studies to monitor degree of the dilatation in pelvis, and nuclear studies to evaluate kidney functions. Indications for surgery are progressive hydronephrosis and decreasing renal functions. Close follow-up of hydronephrosis provides valuable data in detecting patients whose kidneys will deteriorate before renal injury occurs; thus makes monitoring the degree of pelvic dilatation an important aspect of follow-up in UPJO. As SFU grading serves a rough definition of hydronephrosis; measurement of mAPD is commonly used as a more comparable and sensitive parameter. An important fact that has to be kept in mind at this point is the known augmenting effect of hydration on renal pelvic diameter. In 1977, Ernst Hasch studied pelvic dilatation in hydronephrotic kidneys before and after fluid intake. The increase in the dilatation following fluid intake was statistically significant. Hasch recommended a fasting ultrasound scan in order to exclude or diagnose a persistent hydronephrosis and also another scan after fluid intake in order not to overlook a case of intermittent hydronephrosis.³ Similar consistent findings were then reported and different sonographic techniques like diuretic sonography or evaluation of resistive index by using Doppler ultrasonography to overcome this issue were designated; however, did not gain popularity due to the complexity in application.⁶⁻¹¹

Our results were consistent with these previous reports confirming the augmenting effect of hydration on hydronephrosis, and revealed that about ten percent increase of mAPD by hydration is not exceptional even in the conditions eliminat-

ing the differences due to performer and the device. Therefore, fasting ultrasonography like Hasch offered might be performed in indeterminate cases.

More importantly, the focus of our study which we would like to emphasize was the observation that; the diameter measured at renal hilum is less affected by hydration than the maximum pelvic diameter. The renal pelvis appears to be less compliant at renal hilum. Moreover, despite its wider use, maximum pelvic AP diameter measurements are more prone to user dependent errors and not easy to refer. Therefore, inclusion of measurement of the pelvis diameter at the hilum in routine urinary tract examination may increase the quality and the reproducibility of the study.

This study was constructed as a starting point to figure out one of the main problems in our UPJO follow-up protocols and certainly has restrictions due to the smallness of our group; however, has some definite results both defining the problem and offering a possible solution.

CONCLUSION

Hydration significantly affects hydronephrosis and consequently the maximum diameter of the renal pelvis in children with ureteropelvic junction obstruction, and therefore an increase about ten percent detected in a single examination may need confirmation. Our study contributes to the technique by revealing that pelvic APD at renal hilum is less affected and seems to be independent of hydration status, and thus shall be included in routine sonographic examinations used for the follow-up of hydronephrosis.

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