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Predict pregnancy outcomes of prenatal megaureter by prenatal ultrasonography

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Summary

Purpose of Investigation: To evaluate clinical and ultrasonographic characteristics of prenatally diagnosed megaureter to predict postnatal outcomes. *Materials and Methods:* This retrospective study was conducted on eight fetuses with megaureter which was defined 5 mm or more in diameter of distal ureter in prenatal ultrasonography between March 2008 and September 2015. The authors investigated gestational age at diagnosis and delivery, Z-score for birth weight, progression of ureter diameter, and grade of hydronephrosis between prenatal and postnatal period, neonatal outcomes. *Results:* Six cases had unilateral megaureter and two cases had both. Of a total of ten renal units (RU), six RU were on the left side. Median gestational age at diagnosis of megaureter was 32.4 weeks and Z-score for birth weight was -0.88. The last mean ureter dilatation before delivery was 13.3 mm. The median postnatal ureter diameter was 9.5 mm. Number of grade II megaureter was five at the time of diagnosis. All were Group III after birth. The causes of megaureter were classified as follows: four RU of obstructed type at the vesicoureteric junction, one RU of refluxing type, two RU of mixed type, two RU in secondary type, and one RU resolved spontaneously after delivery. Three cases were conservatively managed, while five cases required invasive interventions. Megaureters were managed invasively had a tendency to be diagnosed at an earlier gestational age, in males, bilateral megaureters, combined anomalies, and lower Z-score for birthweight. *Conclusion:* On prenatal ultrasound, megaureter diagnosed at earlier gestational age, male sex, bilateral megaureters, and lower Z-score for birthweight may more likely require invasive management.

Key words: Urogenital abnormalities; Hydronephrosis; Ultrasonography; Prenatal diagnosis.

Introduction

The diameter of a normal ureter is rarely more than five mm in newborns [1]. Therefore, megaureter is defined as a ureter dilated more than 5 mm located above the ureterovesical junction [2-4]. Diagnosis is made with clinical findings, not by a specific pathological clue [5]. Prior to widespread use of prenatal ultrasonography, diagnosis of megaureter was primarily based on symptomatic findings such as fever due to urinary tract infection, lateral abdominal lesion pain, palpable abdominal mass, and hematuria [5, 6].

Recently, megaureter are detected more frequently and accurately found as a result of the popularization and development of prenatal ultrasonography. About 89% of megaureter resolved completely with conservative treatment over a median period of 7.3 years [7]. However, surgical correction could be helpful if hydronephrosis is greater than Grade III, or the ureter diameter is more than ten mm [8]. The present authors study clinical and ultrasonographic characteristics of megaureter in antepartum period to predict outcomes after birth.

Materials and Methods

From March 2008 to September 2015, the authors retrospectively analyzed fetuses diagnosed with fetal megaureter and delivered at Gachon University Gil Medical Center. All patients were referred by a local hospital with ureter dilatation or other abnormalities found in Level II sonograms performed after the second trimester. Stillbirths, major anomalies, and loss of follow up were excluded, hence eight cases of prenatal megaureter were finally analyzed. Megaureter is defined as 5 mm or more in diameter of ureter located at the level between the renal pelvis and ureterovesical junction. The authors measured the maximum diameter of the distal ureter on coronal view respectively three times at time of diagnosis, within two weeks before delivery, and after birth. Megaureter can be graded from I to III based on morphological appearance by the Pfister-Hendren's classification. Type I is dilatation of only the distal ureter, without involvement of the upper, Type II is dilated up to the pelvis, and Type III is associated with ureter tortuosity or severe hydronephrosis [9]. Hydronephrosis was classified by grading I-IV, according to the grading system of the Society for Fetal Urology (SFU). The authors investigated gestational age at diagnosis, maternal clinical characteristics, and neonatal outcomes included five-minute Apgar score, Z-score for birth weight, associated anomalies, and selective treatment options of megaureter. Imaging studies including abdomen computed tomography and sonography, voiding cystourethrography (VCUG), renal scan (99mTc-MAG3, 99mTc-DMSA), and pyelography conducted in the postnatal period were used in evaluating the type of megaureter. The authors performed postnatal ultrasounds between 48 hours and seven days [3, 9, 10] because megaureter could not be checked if the newborn had physiologic volume depletion or oliguria. Prophylactic antibiotics

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Table 1. — *Clinical characteristics of megaureter.*

Case No.	MA† (yrs)	Parity	GA‡ at diagnosis (wks)	GA at delivery (wks)	BW§ (g)	Z-score for BW	Sex	Combined anomaly Prenatal	Postnatal
1	31	0	21.4	41.5	3790	0.73	M	-	-
2	33	1	33.2	38.5	2910	-0.88	F	Rt. pelvic kidney	Rt. pelvic kidney
3	30	3	36.5	39.2	2470	-2.14	F	-	-
4	29	1	28.0	39.2	3630	1.17	F	Polycystic kidney	Horseshoe kidney Biscuspid aortic valve
5	36	1	37.1	38.2	2910	-0.94	M	Megacystis, Bladder outlet obstruction	Lt. hydrocele
6	37	1	31.6	38.2	2920	-0.91	M	-	Posterior urethral membrane
7	22	0	33.5	36.0	2090	-1.71	F	-	Imperforate anus Vaginal aplasia
8	33	0	29.4	39.1	3060	-0.77	M	Lt. abdominal cystic lesion	Bilateral adrenal hemorrhage
Median /n (%)[a)]	32	1	32.4	38.9	2915	-0.88	M:4/ F:4	4 (50.0%)	6 (75.0%)

† MA: maternal age. ‡GA: gestational age. §BW: birth weight. a)Values are presented as median, number, or percentage (%).

Table 2. — *Sonographic characteristics of megaureter.*

Case No.	Ureter diameter (mm)		Location b)			Megaureter classification			Gr† of hydronephrosis	
	At diagnosis	Before birth	After birth	Lt	Rt	At diagnosis	Before birth	After birth	Before birth	After birth
1	5.7	32.0	24.2		+	II	III	III	III	III
2	22.6	16.7	10.1		+	III	III	III	-	I
3	8.5	13.5	10.3	+		III	III	III	IV	IV
4	5.7	13.0	8.8	+		II	II	III	I	II
5	5.0	5.8	7.4	+		II	II	III	II	II
	-	-	6.3[c)]		+			III	-	-
6	7.3	7.0	6.5	+		II	III	III	III	II
	6.3	6.0	6.7		+	II	III	III	III	II
7	16.7	14.7	17.6	+		III	III	III	IV	IV
8	5.9	7.5	3.1	+		I	I	Resolution[d)]	-	-
Median / n (%)[a)]	6.3	13.3	9.5	6 (60.0%)	4 (40.0%)	II (55.6%)	III (66.7%)	III (100%)	7 (77.8%)	8 (88.9%)

† Gr: grade; a) Values are presented as median, number, or percentage (%). b)Location of the hydronephrosis: left, right, both. c)In this case, megaureter was not found by antenatal sonography on the right side, but after delivery was checked for megaureter. d)In this case, after delivery, megaureter one RU resolved spontaneously.

were administered to all neonates until the megaureter improved or resolved.

Results

In the present institution, eight cases of megaureter were detected by prenatal sonography performed until delivery. The median maternal age was 32 (22-37) years, and three women (37.5%) were nulliparous. The median gestational age at prenatal diagnosis of megaureter was 32.4 (21.4-37.1) weeks and the interval from diagnosis of prenatal megaureter to delivery was 41.5 (7-145) days. The median gestational age (GA) at delivery was 38.9 (36-41.5) weeks, birthweight was 2,915 (2,090-3,790) grams, and Z-score for birthweight was -0.88. Of the eight neonates, four (50%) were male and six (75%) neonates were diagnosed with additional anomalies. Urogenital anomalies were found in six (75%) fetuses without oligohydramnios during gestation such as pelvic kidney, horse-shoe kidney, bicuspid aortic valve, posterior urethral membrane, imperforate anus, bilateral adrenal hemorrhage, and vaginal aplasia (Table 1). A total of ten renal units (RU) was analyzed because two cases had both megaureters, six (60%) RU of megaureter located on the left side. The median diameter of the ureter at diagnosis was 6.3 (5-22.6) mm, the final diameter before delivery was 13.3 (5.8-32) mm, and the mean postnatal diameter of ureter was 9.5 (3.1-24.2) mm. Five (55.6%) RU of megaureter were classified as Grade II at the time of diagnosis, but all were reclassified as Group III after birth. In six cases, seven RU of megaureter were checked with hydronephrosis during pregnancy. Seven cases, eight RU of megaureter were confirmed with postnatal diagnosis of hydronephrosis (Table 2). The median observation period lasted six (1- 371) days, from de-

Table 3. — *Postnatal evaluation and management of megaureter.*

Case No.	Imaging studies	Megaureter type				Management		
		Primary			Secondary	Conservative	Invasive	
		Obst†	Ref†	Mixed			Option	Observation (days) d)
1	Sonography Abd. CT‡, AGP§	+					PCN¶ (Rt.)	6
2	Sonography, VCUG‡		+			+	-	-
3	Sonography, VCUG Renal scan	+				+	-	-
4	Sonography, VCUG Abd.CT‡, RGP§, IVP§	+					PCN (Lt.) D-J insertion¶ (Lt.) Ureteroureterostomy (Lt.)	16
5	Sonography, VCUG Renal scan			+/+			Cohen OP b) Hydrocelectomy (Lt.)	371
6	Sonography, VCUG				+/+		Vesicostomy	2
7	Sonography	+					PCN (Lt.) Sigmoid-loop colostomy	1
8 c)	Sonography, Abd. CT					+	-	-
Median /n(%) a)		4 (44.4%)	1 (11.1%)	2 (22.2%)	2 (22.2%)	3 (37.5%)	5 (62.5%)	6

†*Obst: obstructed. Ref:refluxing.* ‡*Abd. CT: abdominal computerized tomography. VCUG: voiding cystourethrography.* §*AGP: antegrade pyelography. RGP: retrograde pyelography. IVP: intravenous pyelography.* ¶*PCN: percutaneous nephrostomy. D-J: double J stent.* a) *Values are presented as median, number, or percentage (%).* b) *Re-implanting the ureters into the bladder,.* c) *In this case, after delivery, megaureter one RU resolved spontaneously.* d) *Observation period to decide invasive procedure.*

Table 4. — *Compare clinical and sonographic characteristics according to treatment.*

			Invasive treatment (5 cases, 7 RU)	Conservative treatment (3 cases, 3 RU) a)
MA† (years)			31.0 (22.0-37.0) b)	33.0 (30.0-33.0)
GA† at delivery (weeks)			38.2 (36.0-41.5)	39.1 (38.5-39.2)
BW‡ for Z-score			-0.92 (-1.71-1.17)	-0.85 (-2.14- -0.77)
Male Sex			3 (60.0%)	1 (33.3%)
GA at diagnosis (weeks)			31.6 (21.4-38.1)	33.2 (29.4-36.5)
Associated anomaly (cases)			4 (80.0%)	2 (66.6%)
Diameter of ureter (mm)	At Dx		6.0 (5.0-16.7)	8.5 (5.9-22.6)
	Before birth		10 (5.8-32.0)	13.5 (7.5-16.7)
	After birth		7.4 (6.3-24.2)	10.1 (3.1-10.3)
Location (RU‡)	Unilateral	Lt	2 (28.6%)	2 (66.7%)
		Rt	1 (14.3%)	1 (33.3%)
	Both		4 (57.1%)	-
Megaureter type (RU)	Primary	Obst§	3 (42.7%)	1 (33.3%)
		Ref§	-	1 (33.3%)
		Mixed	2 (28.6%)	-
	Secondary		2 (28.6%)	-
	Resolution		-	1 (33.3%)
Megaureter classification (RU)	At Dx		II (5, 71.4%)	III (2, 66.7%)
	Before birth		III (4, 57.1%)	III (2, 66.7%)
	After birth		III (7, 100%)	III (2, 66.7%)

†*MA: Maternal age. GA: gestational age.* ‡*BW: birth weight. RU: renal unit;* §*Obst: obstructed. Ref: refluxing.*

a) *Containing case No.8 which resolved spontaneously after birth.* b) *Values are presented as median, number, range, or percentage (%).*

livery to the intervention decision, for monitoring urinary output, and neonate condition. Primary megaureter is defined as a functional or anatomical abnormality involving the ureterovesical junction, whereas secondary megaureter results from abnormalities that involve the bladder or urethra. In the present series, the authors classified seven RU as primary megaureter, two RU as secondary megaureter, and one RU as not verifiable because it resolved spontaneously. From imaging studies, megaureter is classified into four main categories: obstructed, refluxing, obstructed and refluxing, and non-obstructive and non-refluxing [11]. The present found that four (44.4%) RU were obstructed type of

vesicoureteric junction, one (11.1%) RU of refluxed type, and two (22.2%) RU combined obstructed and refluxed type. Three cases (37.5%) of megaureter were conservatively managed, including one RU that resolved spontaneously during postnatal evaluation. Five cases (62.5%) required invasive interventions: three percutaneous nephrostomy (PCN), one vesicostomy, one ureteroureterostomy, and one re-implanting the ureters into the bladder. In the event that the megaureter is an obstructive type or the grade of the megaureter does not improve, a D-J insertion, ureteroureterostomy or Cohen operation may be considered. Another invasive treatment option for megaureters is a vesicostomy for megaureter cases complicated with bladder outlet obstructions. Finally PCN becomes an effective treatment in this case since the procedure will relieve axis abnormalities and mass effects of hydronephrosis. Thereafter, there were no recurrent or critical complications. The median follow up period was 234 (4-2220) days and there was no neonatal death (Table 3). The authors compared clinical characteristics and sonographic findings between conservative management and invasive management. In invasive management, the median ureter diameter did not increase and did not progress to advanced stage of megaureter. In invasive management of neonates, diagnosis was made at an earlier gestational age, smaller birth weight, male sex, bilateral megaureter, and obstructive type (Table 4).

Discussion

Prenatal ultrasounds improved the detection and treatment of many gestational genitourinary anomalies [7, 11]. Normal ureters are seldom identified in routine prenatal ultrasonography [10], but abnormal dilatation of the ureter is seen. Megaureters are three to five times more common in males than females [4, 7, 12, 13] but in this study, the authors found the ratio of between genders to be equal. The left unilateral ureter is 1.6~4.5 times more likely to be affected than the right side [3, 14]. Most megaureters resolve spontaneously, presumably with maturation of the vesicoureteral junction [7, 12, 15-17]. One renal unit in this series was found to have only left ureteral dilatation in the prenatal scan, but after birth megaureter was identified in not only in the left side but also in the right side. Another patient diagnosed with megaureter at prenatal ultrasonography no longer had a ureteral dilation after delivery. Although spontaneous resolution of megaureter is a common clinical event, clinicians should consider invasive management in certain cases and counsel parents accordingly. Grade 4 to 5 hydronephrosis or a ureter diameter of more than 10 mm located above retrovesical level were more likely to need surgical treatment [9] because of the association with impaired drainage during urination [12]. With regards to grade of megaureter, all the megaureters operated on were more than grade III with severe hydronephrosis [10]. The present data showed that 62.5% required invasive management even in cases where median diameter of ureter was not larger and classification was not significantly higher because ureter diameter may vary depending on fetal growth, urination, and peristalsis of ureter. Early onset of dilated ureter during gestation, male sex, smaller birthweight, bilateral dilatation, and obstructive type of megaureter showed a tendency correlated with invasive management. Those too small for invasive methods in this series could not be analyzed for lack of statistical power.

Megaureter is often combined with other fetal anomalies. The genitourinary tract is the most common comorbidity, and 40.8% of the present cases were diagnosed with urogenital anomalies. Eighty percent of the cases with combined anomalies required invasive management. So if there is suspicion of megaureter prenatally, careful further evaluation for associated anomalies is needed before and after birth. The present study analyzed a small number of cases that limits statistical significance, but the authors were able to conduct long-term observation of the neonates with megaureter diagnosed prenatally showing their clinical course and management. The authors will continue their clinical observation with these patients and include new patients who are being enrolled for further study to understand their clinical course and to seek risk factors for prognosis in megaureter. In conclusion, careful prenatal sonographic surveillance of megaureter is helpful to predict outcome and postnatal evaluation is required for the deciding optimal time for appropriate intervention to improved perinatal outcome.

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