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ORIGINAL ARTICLE

Unilateral multicystic dysplastic kidney: single-center experience

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Abstract Multicystic dysplastic kidney (MCDK) is one of the most common renal abnormalities in children. The aim of our study was to evaluate the clinical course and outcome of patients with MCDK. Ninety pediatric patients with unilateral MCDK followed by the Pediatric Nephrology Department of Bakırkoy Maternity and Children's Hospital between 1990 and 2007 were included in this retrospective study. The dimercaptosuccinic acid radionuclide scan revealed no function in MCDK in all of our patients. Voiding cystourethrogram was performed in all patients. Twenty patients (22.2%) had abnormalities in the contralateral kidney. Nephrectomy was performed in 41 patients (45.5%). Twelve patients had undergone routine nephrectomy before 1996. Since then, patients have been followed up conservatively, and nephrectomy has been performed only when indicated. Indication of nephrectomy was arterial hypertension in 16 patients (23.1%), recurrent urinary tract infection (UTI) in 11 (15.9%), and severe abdominal pain in two (2.8%). Hypertension was noted within the first year of life in all patients except two. MCDK completely involuted in 39.3% within 48 months. There was no malignant transformation, proteinuria, or renal failure. In conclusion, hypertension is often noticed in infants with MCDK. Uninephrectomy leads to normalization. However, prospective studies are needed to exclude a spontaneous improvement of hypertension.

Keywords Multicystic · Dysplastic · Kidney · Children · Hypertension

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Introduction

Multicystic dysplastic kidney (MCDK) is one of the most common renal abnormalities detected by prenatal ultrasound (US) [1–3]. MCDK is usually a unilateral disorder, and children with unilateral MCDK have a good prognosis [1, 2]. Bilateral MCDK is rare and usually fatal [1, 2, 4]. Although familial cases have been identified, MCDK is generally accepted to be a sporadic disease [1, 2, 5–8]. MCDK is a nonfunctioning tissue characterized by multiple varying sized noncommunicating cysts on US examination [1, 9, 10]. There is no function detected on the dimercaptosuccinic acid (DMSA) radionuclide scan of MCDK [1, 2]. MCDK may undergo complete or partial involution with time [1, 2, 9, 11, 12–15].

Malignant transformation [1, 2, 16–18] and hypertension [1, 2, 19–22] associated with MCDK have been reported in the literature. Routine nephrectomy was performed in many centers to prevent those complications before 1990. However, according to recent reports, the necessity of routine nephrectomy is controversial [3, 10, 11, 13, 23–25]. Moreover, MCDK is likely to be associated with additional

abnormalities of the urogenital system, including vesicoureteral reflux (VUR) [26–30]. As patients with MCDK have only one functioning kidney, abnormalities of the contralateral kidney directly affect the prognosis. Some reports recommend performing voiding cystourethrogram (VCUG) to investigate VUR into the contralateral kidney in all patients with MCDK, whereas the others advocate that routine VCUG is unnecessary [3, 10, 25, 31, 32]. The aim of this study was to evaluate the clinical course and outcome of our patients with MCDK to discuss the diagnostic approach, follow-up, and treatment of those patients.

Patients and methods

Our study group consisted of 90 patients with unilateral MCDK who were followed up in our clinic between 1990 and 2007. MCDK was diagnosed with the presence of multiple, varying sized, noncommunicating cysts and without identifiable renal parenchyma by US. DMSA and VCUG were performed in all patients. According to our protocol, patients were assessed with blood pressure measurement, urinalysis, and urinary culture every month during the first 6 months of life and every 3 months during the second 6 months of life. The same assessment was performed every 6 months between 1 and 2 years of age and annually thereafter. US examination was performed every 6 months in the first year of life and once a year thereafter. Serum urea, creatinine, and electrolytes were analyzed annually.

Complete involution was defined as MCDK disappearance, and partial involution was defined as MCDK size reduction on US examination. Compensatory hypertrophy of the contralateral kidney was defined as renal length >2 standard deviations (SD) of the mean value of normal kidneys according to age.

Blood pressure measurements were performed by Doppler. Hypertension was defined as systolic and/or diastolic blood pressure >95th percentile for age and gender. When high blood pressure was established in routine examination, the patient was followed up in the hospital, and serial blood pressure measurements were performed for at least 3 days in order to diagnose hypertension. When hypertension was present, the patient was treated with antihypertensive drugs until nephrectomy.

Urinary tract infection (UTI) was diagnosed if there were leukocyturia in the microscopic analysis and significant bacteriuria (≥100,000 cfu/ml) in the urinary culture. Twelve patients had undergone routine nephrectomy before admission to our nephrology department before 1996. Patients have been followed up conservatively, and since 1996, nephrectomy has been performed only in the patients with hypertension, UTI relapses, or mass effect.

Results

Ninety children (37 girls and 53 boys) diagnosed with unilateral MCDK on US were admitted to our hospital between 1990 and 2007. There was no function on the DMSA scan in any of our patients. Fifty-nine (65.5%) were diagnosed in the prenatal period. Unilateral MCDK was on the right side in 44 patients (48.8%) and on the left side in 46 patients (51.2%) (Table 1). There was no bilateral or familial MCDK in our study group.

Twenty patients (22.2%) showed abnormalities of the contralateral kidney. The rate of abnormalities is given in Table 1. VUR was detected in seven cases (7.7%), and two of them had antireflux procedure. Data of the patients with VUR is given in Table 2.

Twenty-one patients were excluded from the study because their follow-up durations were under 1 year. Mean follow-up of the remaining 69 patients was 54.76± 39.43 (range 12–120) months. Nephrectomy was performed in 41 patients (59.4%). Twelve had undergone routine nephrectomy before 1996 (17.3%). Patients have been followed up conservatively, and nephrectomy has been performed only when indicated since 1996. Indications for nephrectomy were arterial hypertension in 16 patients (23.1%), recurrent UTI in 11 (15.9%), and severe abdominal

Table 1 Patient characteristics and additional abnormalities

Characteristics	Number (%)
Total	90 (100)
Gender	
Male	53 (58.8)
Female	37 (41.2)
Side of MCDK	
Right	44 (48.8)
Left	46 (51.2)
Time of diagnosis	
Prenatal US	59 (65.5)
Postnatal US	31 (34.5)
Abnormalities of contralateral kidney	20 (22.2)
VUR	7 (7.7)
UPJ obstruction	1 (1.1)
Nonobstructive upper tract dilatation	6 (6.6)
UVJ obstruction + ureterocele	2 (2.2)
Duplex system	2 (2.2)
Nephrolithiasis	2 (2.2)
Nonrenal abnormalities	9 (10)
Congenital heart defect	4 (4.4)
Cryptorchidy	2 (2.2)
Club foot	1 (1.1)
Inguinal hernia	1 (1.1)
Ovarian cysts	1 (1.1)

US ultrasound, *VUR* vesicoureteral reflux, *UPJ* ureteropelvic junction, *UVJ* ureterovesical junction

Table 2 Data of patients with vesicoureteral reflux (VUR)

Patients	Grade of VUR	US findings of contralateral kidney	UTI
1	V	Hydroureteronephrosis	(+)
2	III	Hydroureteronephrosis	(+)
3	II	Ureterocele	(+)
4	II	Renal ptosis	(+)
5	II	Normal	(+)
6	II	Normal	(-)
7	II	Normal	(-)

US ultrasound, *UTI* urinary tract infection

pain in two (2.8%) (Table 3). There was no renal scarring in the contralateral kidney in patients with hypertension. Hypertension was determined within the first year of life, except for two (Table 4). All cases with hypertension underwent nephrectomy. Blood pressure levels were in the normal range in all children after the operation.

Of the 69 patients, 24 (34.7%) had UTI during the follow-up. Isolated microorganisms of 24 patients were as follows: *Escherichia coli* 47.72%, gram-negative bacillus 45.45%, *Proteus* 4.54%, and *Klebsiella* 2.27%. Of 24 patients, six (25%) had attended our hospital for recurrent UTI, and the diagnosis of MCDK was made during UTI evaluation. Distribution of renal abnormalities of the contralateral kidney that led to UTI was as follows: grade II-III VUR (3), ureteropelvic junction (UPJ) obstruction (1), nonobstructive dilatation of upper tract (3), ureterovesical junction obstruction (UVJ) and ureterocele (1), duplex system (1), and nephrolithiasis (1). Additionally, ipsilateral VUR was detected in three patients who had recurrent UTI. Furthermore, 14 children with normal contralateral kidney also manifested UTI. Of the 24 patients with UTI, ten were boys, and seven of them were circumcised. No renal scarring in the contralateral kidney could be determined in patients who had UTI during follow-up.

Eleven children underwent nephrectomy due to recurrent UTI. The underlying anatomic disorders of the contralateral kidney were VUR (2), nonobstructive dilatation of upper tract (3), and nephrolithiasis (1). No symptomatic UTI was noted in those children after operation, except for one patient with VUR into the contralateral kidney. UTI recurrences continued until the contralateral VUR improved spontaneously 1 year after nephrectomy. The other patient with contralateral VUR underwent antireflux procedure before nephrectomy.

We also evaluated involution rate of the MCDK. Forty-one patients with previous nephrectomy and 21 in whom the follow-up duration was shorter than 1 year were excluded from the study. Of the 28 remaining patients, MCDK had completely involuted in 11 (39.3%) within 48 months. Partial involution was observed in six children (21.4%), and the dimensions of MCDK remained unchanged in 11 patients (39.3%) during follow-up. We observed that the dysplastic tissue persisted in 60.7% of our patients, and the mean follow-up duration of those children was 43.7 (range 12–120) months (Table 3).

Compensatory hypertrophy of the contralateral kidney was detected in 62 patients (89.8%). Of the seven patients without hypertrophy in the contralateral kidney, three had abnormalities of the contralateral kidney (VUR in one patient, UPJ obstruction in one, and renal ptosis in one). There is no malignant transformation, proteinuria, or renal failure in our study group.

Discussion

Patients with MCDK have only one functioning kidney, and abnormalities of the contralateral kidney play a crucial role in the prognosis. The rate of additional abnormalities of the contralateral kidney has been reported to be between 15.3% and 42% [3, 12, 23–25, 27, 29, 31–37]. Damen-Elias et al. added cystoscopy and colposcopy to routine investigation, and the rate of detected urogenital anomalies reached 75% [30]. Contralateral VUR rate has been noted between 5% and 25.3% in previous reports [3, 14, 15, 25–27, 30, 32, 34–36, 38]. Therefore, some authors advocate that VCUG should be performed in all patients with MCDK to determine contralateral VUR [25, 34, 38]. According to other authors, routine VCUG was not necessary, because VUR was usually low grade when US assessment was normal [3, 31, 32, 37, 39]. Ismaili et al. suggested that clinically significant contralateral anomalies could be ruled out by two successive normal renal US performed at the third day and at the end of the first month of life [40]. In our study group, the rate of anomalies of the contralateral kidney was 22.2%, but only seven patients (7.7%) had contralateral VUR. VUR was low grade in six patients.

Table 3 Follow-up of multicystic dysplastic kidney (MCDK)

	Number (%)
Total	69 (100)
Nephroureterectomy	41 (59.4)
Routine nephroureterectomy	12 (17.3)
Indications of nephroureterectomy	
Hypertension	16 (23.1)
Urinary tract infection	11 (15.9)
Severe abdominal pain	2 (2.8)
Conservative follow-up (>1 year)	28 (40.5)
Complete involution	11 (39.3)
Partial involution	6 (21.4)
No change	11 (39.3)

Table 4 Patients with hypertension

Patient	Gender	Birth date	Age HT began	Preop BP (mmHg)	Antihypertensive therapy	Time between diagnosis and nephrectomy (days)	Date of nephrectomy	Postop BP (mmHg)
1	M	Jan 01	5 months	DNR	Nifedipine	30	Jun 01	80/50
2	F	Sep 06	7 months	123/96	Nifedipine	36	May 07	83/52
3	F	Nov 05	11 months	123/71	Nifedipine	30	Nov 06	98/56
4	M	Dec 98	6 months	DNR	Nifedipine	24	May 99	86/58
5	F	Aug 05	44 days	130/80	Nifedipine	17	Oct 05	87/27
6	M	Sep 01	3 months	110/82	Nifedipine	15	Jan 02	85/56
7	M	Mar 07	15 days	135/61	Nifedipine	30	Apr 07	83/59
8	M	Sep 03	4 days	115/70	Captopril and Propranolol	30	Nov 03	81/53
9	F	Oct 02	4 months	110/70	Nifedipine	39	Mar 03	86/54
10	F	Apr 97	40 days	DNR	Nifedipine	23	Jun 97	82/64
11	F	Aug 05	1 month	113/63	Nifedipine and Captopril	11	Sep 05	80/50
12	F	May 98	6 months	112/73	Nifedipine	10	Nov 98	88/56
13	M	Apr 02	12 months	110/93	Nifedipine	30	May 03	80/62
14	F	Nov 98	7 months	DNR	Nifedipine	35	Jul 98	90/62
15	M	Aug 85	13 years	DNR	Nifedipine	28	Feb 98	105/70
16	M	Feb 03	2 years	DNR	Nifedipine	30	Apr 05	96/63

DNR data not recorded in the patient file, *HT* hypertension, *BP* blood pressure

Contralateral VUR rate was low in our study group. Kuwertz-Broeking et al. [32] reported that VCUG was performed 89 patients and only four of them (5%) had contralateral VUR. Moreover, Eckoldt et al. [25] reported that only six (6.8%) of 88 children with MCDK had contralateral VUR. Those reports are similar to our study regarding the number of patients and the rate of VUR into the contralateral kidney.

UTI rate in patients with MCDK has been reported to be between 3.6% and 19% [12, 27, 32, 35, 36]. In our study group, UTI was detected 34.7% of patients, and this figure is significantly higher than the rate in the other reports. MCDK diagnosis was made during UTI evaluation in 25% of our patients who had UTI. Hence, our UTI rates seem to be much higher.

Compensatory hypertrophy of the contralateral kidney is generally expected in patients with MCDK [1, 2]. The frequency of compensatory hypertrophy has been reported to be between 43% and 100% [31–34, 36]. Our result was 89.8% and was in line with the literature. It is considered that if there is no hypertrophy, the contralateral kidney is likely to have an abnormality. Seven of our patients had no compensatory hypertrophy of the contralateral kidney. Only three of them had an abnormality, and four had no detected abnormality in the contralateral kidney. We cannot explain why compensatory hypertrophy was not observed in all cases, but it may be possible to observe it during longer follow-up.

It is well known that kidneys with MCDK involute with time, but there are conflicting data about the time of involution in the literature. It has been reported that approximately 40% of MCDK underwent involution in the first 30 months of life [12, 25]. Alconcher et al. reported that complete involution rate in their study group was 55.5% over a mean period of 18 months [31]. Ylinen et al. suggested that significant involution did not occur after 18 months in their study group [24]. Aslam et al. reported that complete involution rate was 33% over 24 months, 47% over 60 months, and 59% ove 120 months [3]. Rabelo et al. noted that the mean time of complete involution was 122 months in their study group, but the rate of involution was higher during the first 30 months of age than in older patients [33, 37]. MCDK completely involuted in 39.3% of our study group within 48 months, and the dysplastic tissue persisted in 60.7%.

Routine nephrectomy has been recommended by some investigators to avoid malignant transformation, hypertension, and cost of a long follow-up [13, 27]. Other authors suggested conservative follow-up with blood pressure measurement and US examination, because MCDK often undergoes involution, and complications such as malignant transformation and hypertension are rare [3, 23, 25, 31–37]. Malignant transformation has been reported to be very rare [1, 2, 16–18]. There were no signs of malignant transformation with US examination and histopathologic evaluation of nephrectomy materials in our patients.

The rate of hypertension has been reported to be between 0% and 5% [3, 23–25, 27, 29, 32, 33, 35–37]. However, we determined hypertension in 16 of our patients, and 14 of them were younger than 1 year old (Tables 3 and 4). When 12 patients who underwent routine nephrectomy and 21 whose follow-up was shorter than 1 year were excluded,

hypertension rate was 28%. This rate is much higher than the rate in other studies. Our study and results are in contrast to other studies that do not recommend nephrectomy, believing that the late outcome is benign without surgery.

As with other studies, ours has limitations. First, our hospital is a reference center and our patient selection is unique. Five children with MCDK were referred from other hospitals because they had hypertension. Therefore, it is not possible to assess the true incidence of hypertension in MCDK in our population. Second, blood pressure measurements were not performed prospectively and long term. Therefore, the natural history of hypertension still needs to be explored before general recommendations can be given.

Seeman et al. [22] reported the hypertension rate in patients with MCDK to be 20% by ambulatory blood pressure monitoring and noted that abnormalities of the contralateral kidney are responsible for hypertension. The question as to whether an elevation of blood pressure is due to the more affected kidney or to the contralateral kidney cannot be answered by our study design. The weakness of our study is that plasma renin activity was not measured. However, the absence of contralateral kidney pathology and disappearance of hypertension following nephrectomy points to MCDK as the reason for hypertension.

Patients younger than 6 months of age with MCDK were followed by monthly blood pressure measurements in our study, and hypertension was diagnosed in the first 6 months of life in ten of 16 patients. In our patient group, the frequency of hypertension was highest during the first 6 months of life where monthly blood pressure measurements were performed. In other studies, measurements were done with 3- to 6-month intervals. In our opinion, in patients with MCDK, hypertension is more common than expected. Therefore, it is plausible to think that more frequent blood pressure measurements could lead to more frequent detection of hypertension.

However, a higher incidence of hypertension during early monthly measurements compared with measurements thereafter might also point to high blood pressure as a temporary phenomenon. Indeed, disappearance of high blood pressure without nephrectomy has been reported [19]. This suggests that hypertension might be an episodic phenomenon in patients with MCDK. In our patients, nephrectomy was performed approximately 1 month after hypertension was detected. Perhaps if a longer period had been allowed, spontaneous hypertension recovery might have been observed.

Our strategy regarding nephrectomy changed with time. Patients with MCDK were admitted to pediatric surgery department and routine nephrectomy was performed before 1996. Since then, we have performed nephrectomy only in patients with complications such as hypertension, UTI relapses, or mechanical complications. In 11 patients, the indication for nephrectomy was recurrent UTI. As this indication is controversial, and because we cannot be sure that the MCDK was the reason for recurrent UTI, we stopped nephrectomy for UTI in 2002 and follow those patients conservatively. However, we continued to perform nephrectomy in cases of hypertension development. As a consequence of this strategy, we are not able to answer the question as to whether or to what degree hypertension would have disappeared if we would have followed the patients with conservative treatment. As hypertension might disappear spontaneously, we might change our treatment policy again and follow early hypertensive patients with conservative treatment only. We have to wait for the clinical results in those patients before we can give definite recommendations.

In conclusion, hypertension is often observed in infants with MCDK. Uninephrectomy leads to normalization. However, prospective studies are needed to exclude a spontaneous improvement of hypertension.

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