Improved Native Kidney Visualisation and Diagnostic Accuracy of Acquired Cystic Kidney Disease using Non-contrast Magnetic Resonance Imaging in Children

EH Chan[1], KFK Fung[2], JMY Ma[3], PKJ Chan[2], EYH Chan[3], ALT Ma[3], YLE Kan[2]
[1]Department of Diagnostic and Interventional Radiology, Princess Margaret Hospital
[2]Department of Radiology, Hong Kong Children's Hospital
[3]Paediatric Nephrology Centre, Department of Paediatrics and Adolescent Medicine, Hong Kong Children's Hospital

Objectives

To compare the visualisation of native kidneys and diagnostic accuracies of acquired cystic kidney disease (ACKD) using ultrasound (US) and non-contrast Magnetic Resonance Imaging (MRI) in a paediatric population.

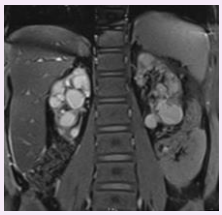
Methods

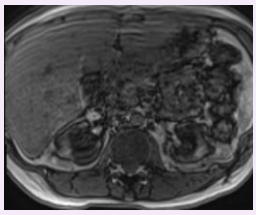
Single-centre retrospective cohort analysis. Patients (≤21 years old) with chronic kidney disease who were on renal replacement therapy or had renal transplant from January 2022 to October 2023 were reviewed. Patients with hereditary or congenital cystic renal disease were excluded. US and non-contrast MRI (Figure 1) performed within 6 months interval were analysed by two paediatric radiologists. ACKD was diagnosed when three or more cysts were detected in either kidney on US or MRI. A visualization score (0, 1 or 2) was assigned to each kidney (Figure 2).

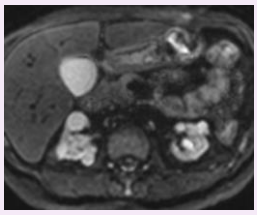
Primary outcome was to compare the visibility of native kidneys and diagnostic accuracies of ACKD between the two imaging modalities. Secondary outcome was to compare the grade of renal cysts using modified Bosniak classification system. Patients with cysts graded Bosniak grade IIF or above on US or MRI would undergo contrast-enhanced CT for confirmation.

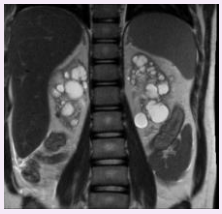
Statistical analysis was performed with SPSS statistics software. Sensitivity and specificity of US and MRI in diagnosis of ACKD and complex cysts were calculated with corresponding 95% CI. McNemar test was used to compare the visualization score of kidneys by laterality on US and MRI. p-value <0.05 was considered statistically significant.

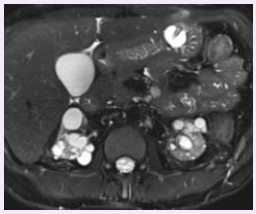
Figure 1. Non-contrast MRI protocol used


Coronal T2W TruFISP FS


Axial T1W Dixon


Axial DWI


Coronal T2W HASTE


Axial T2W HASTE FS

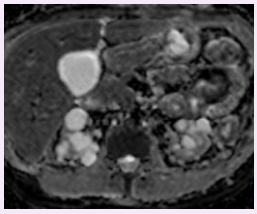
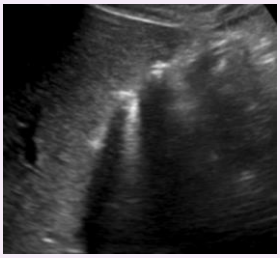
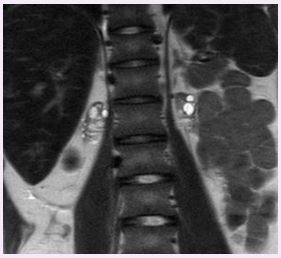

ADC map

Figure 2. Visualization score of kidney on US / MRI


0 = Unable to visualize any of the kidney


1 = ≤50% of the kidney visualized


2 = >50% of the kidney visualized

Results

39 patients were included (age = 14.3 ± 4.3 years, 18 male and 21 female). The prevalence of ACKD was 69.2%. After exclusion of patients with US or MRI performed more than 6 months apart, 63 native kidneys were available for analysis.

Table 1. Total number of cysts detected on US & MRI

	US (n=41)	MRI (n=111)
Simple cysts	26	65
Complex cysts	15	46

Table 2. Visualization score of kidneys on US & MRI

		Right kidney	Left kidney
US	Score = 2	74.2% (23/31)	62.5% (20/32)
	Score = 0 or 1	25.8% (8/31)	37.5% (12/32)
MRI	Score = 2	100% (31/31)	100% (32/32)
	Score = 0 or 1	0% (0/31)	0% (0/32)
		p=0.008	p<0.001

Table 3. Diagnostic accuracies of US & MRI in ACKD and complex cysts

	Sensitivity	Specificity
Diagnosis of ACKD		
US	36.4% (CI 16%-56%)	100%
MRI	100%	100%
Detection of complex cysts		
US	32.6% (CI 19%-46%)	100%
MRI	100%	100%

Table 4. Distribution of Bosniak categories on US & MRI*

Bosniak category	US	Unchanged	Upgraded on MRI	Change from original (%)
I	14	9	5	-36
II	4	3	1	-25
IIF	2	2	0	0

* 7 cases with MRI-detected renal cysts were not visible on US, of which 3 had complex cysts.

Figure 3. 12-year-old girl with ESRF and renal transplant. Both native kidneys were not visible on US. T2W HASTE coronal MRI on the same day showed atrophic native kidneys and the left kidney was low-lying. Multiple bilateral renal cysts were diagnostic of ACKD.

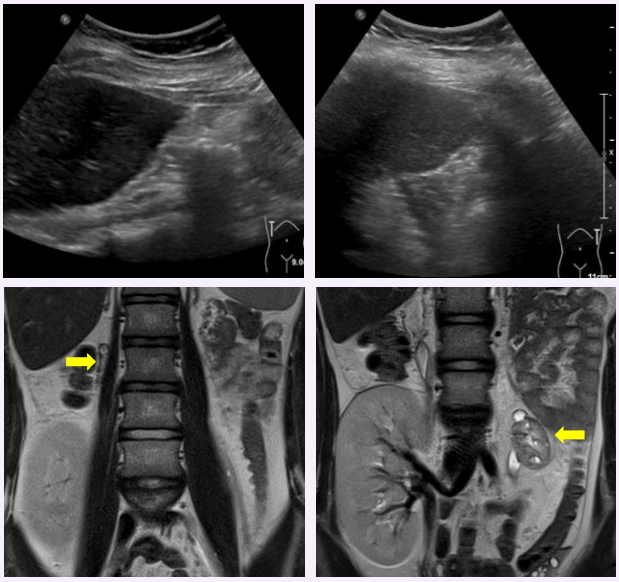
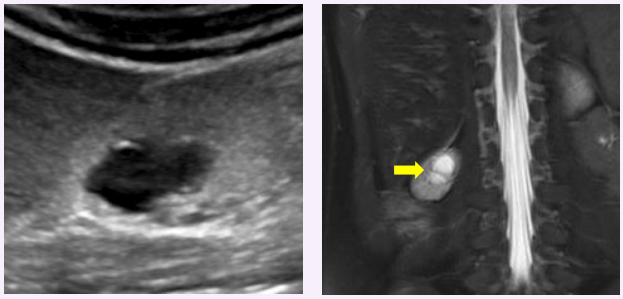


Figure 4. 6-year-old girl with ESRF on haemodialysis. Only one renal cyst with thin septa was detected at right upper pole on US (Bosniak grade II). MRI on the same day showed multiple bilateral renal cysts, diagnostic of ACKD. T2W HASTE FS coronal MRI clearly depicting the right upper pole renal cyst in fact contained thickened septa, suggestive of Bosniak grade IIF instead.



Discussion

Significantly better visualization of bilateral kidneys on MRI, low sensitivity of US in diagnosis of ACKD and complex cysts, and the upgrade of Bosniak category in some of the cases on MRI (Figure 3 and 4) highlight the advantages of MRI in monitoring of ACKD in paediatric patients.

Conclusion

Non-contrast MRI has significantly better visibility of native kidneys and higher sensitivity in diagnosing ACKD compared to US. It may have a role in screening program of ACKD in children.