

KIDNEY VOLUME EVALUATION IN AUTOSOMAL DOMINANT POLYCYSTIC KIDNEY DISEASE (ADPKD) PATIENTS RENAL OUTCOMES

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Introduction - 1

Autosomal dominant polycystic kidney disease (ADPKD) patients present variable degree in progression of kidney disease. Progressive cystic enlargement leads to progressive increase of kidneys' volume, while renal failure usually develops at variable ages according to mutation type (55 years old in PKD1 truncating mutations, 67 years old in non truncating mutations, 79, 7 years old in PKD2 ones) (1).

Progression of renal disease in ADPKD patients cannot be followed according to glomerular filtration rate (GFR) values and it has been known that GFR could not fall before 20 – 40 years. Nephrons' loss is variable according to cysts' growth but inflammation, apoptosis and fibrosis can also occur in healthy parenchymal tissue close to the cysts together with obstructive tubular damage. Meantime, hyperfiltration occurs to preserve GFR (Fig. 1 - *Grantham Nature Reviews Nephrology 2011*).

Introduction - 2

Thus, potential therapeutic approaches delaying progression of kidney disease cannot be evaluated by GFR (2, 3). Several studies have demonstrated significant negative correlation between nuclear magnetic resonance (NMR) evaluated kidney volume and renal function (4).

When 1500 ml kidney volume is achieved, kidney function decline is quite fast (about 4.3 ml/min/1.73 m²/year), while kidney volume presents mean yearly growth of about 5.2% (5).

Therefore, 30% of patients with HtTKV (Height-adjusted Total Kidney Volume) ≥ 600 ml/min developed stage 3 CKD stage 3 in 8 years (6).

Among early kidney failure development prognostic factors, arterial hypertension onset (at an age below 35 years old) and relatives' end-stage renal disease onset (at an age below 55 years old) are described (8). It has been lately developed a kidney volume classification according to NMR or computed tomography (CT) values corrected to height and age (HtTKV).

Classification defines five patients' groups with different GFR decline risk and 5 subclasses (1A to 5E) according to estimated renal growth speed (from 1.5% up to 6%) and yearly GFR reduction (from -0.23 up to -4.78 ml/min/1.73m² in males, and from -0.03 up to -4.58 ml/min/1.73 m² in females (9) (Fig. 2).

Patients and Methods

29 ADPKD patients (12 males and 17 females) were enrolled. eGFR and HtTKV were respectively evaluated by EPI formula and kidney's Nuclear Magnetic Resonance. HtTKV values were between 224 and 3091 cc/m and patients were therefore divided in 5 groups according to previous described classification (see table 1)

NMR was performed by GE 1.5T device with T1, T2, DWI weighted scans. Kidney volume was calculated with Mayo Clinic software CLASSIFICATION OF TYPICAL ADPKD CALCULATOR WEB-BASED APPLICATION (THE "WEB-BASED APPLICATION").

<http://www.mayo.edu/research/documents/pkd-center-adpkd-classification/doc-20094754>.

Kidney volume is evaluated from NMR scans employing ellipsoid equation ($\pi/6 \times L \times W \times D$) (Fig. 3)

Results

eGFR was found between 12 and 107 ml/min/1.73 m² (15 patients showed an EPI eGFR > 60 ml/min/1.73 m², while 14 patients had an EPI eGFR < 60 ml/min/1.73 m²). Among D class patients, 3/4 patients had eGFR < 60 ml/min/1.73 m² as far as 6/7 class E patients. Among class B patients, only one patients showed an EPI eGFR below 60 ml/min/1.73 m² as far as 4/10 class C patients. 20/29 patients were hypertensive with early onset (under 35 years old) in 20 ones. In hypertensive group, an HtTKV > 600 cc/m was observed in 16 patients. ESRD familiar history was observed in 9 patients (3 class C, 1 class D and 5 class E patients).

On each patient a prognostic evaluation was performed according to "slope" model derived by Mayo Clinic classification: 10 years progression towards stage 3 CKD is estimated in 6/15 patients with eGFR > 60 ml/min/m². At the same time, 6/14 patients with eGFR < 60 ml/min/m² were estimated for developing ESRD in a 5 years period, while 6 of them in a 10 years time lapse. Last 2 patients are estimated as stage 4 CKD in a 10 years period (see table 2).

Conclusions

Although conducted on a small patients sample, our data suggest clinical utility of kidney volume assessment in ADPKD patients, especially for prognostic evaluation, allowing to identify patients at higher risk for developing ESRD.

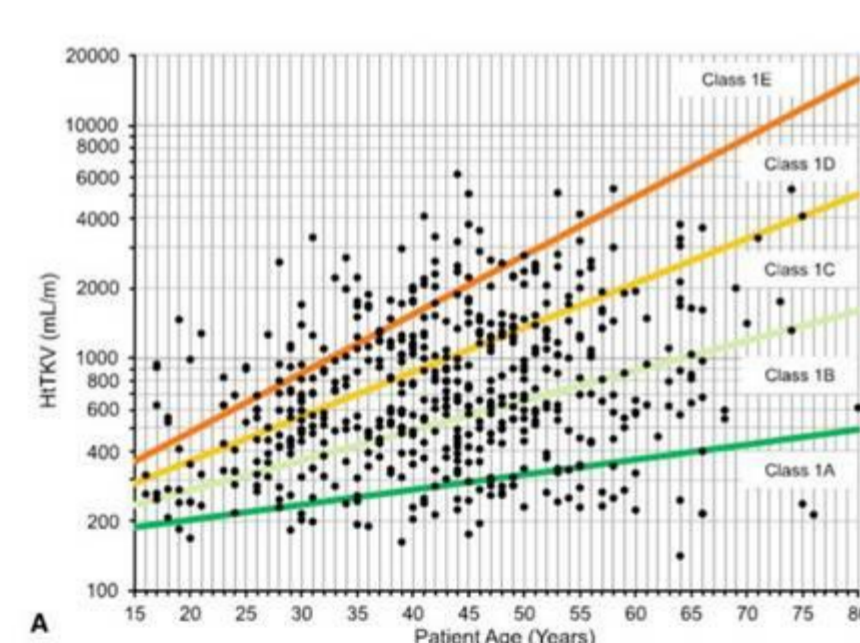


Figure 2

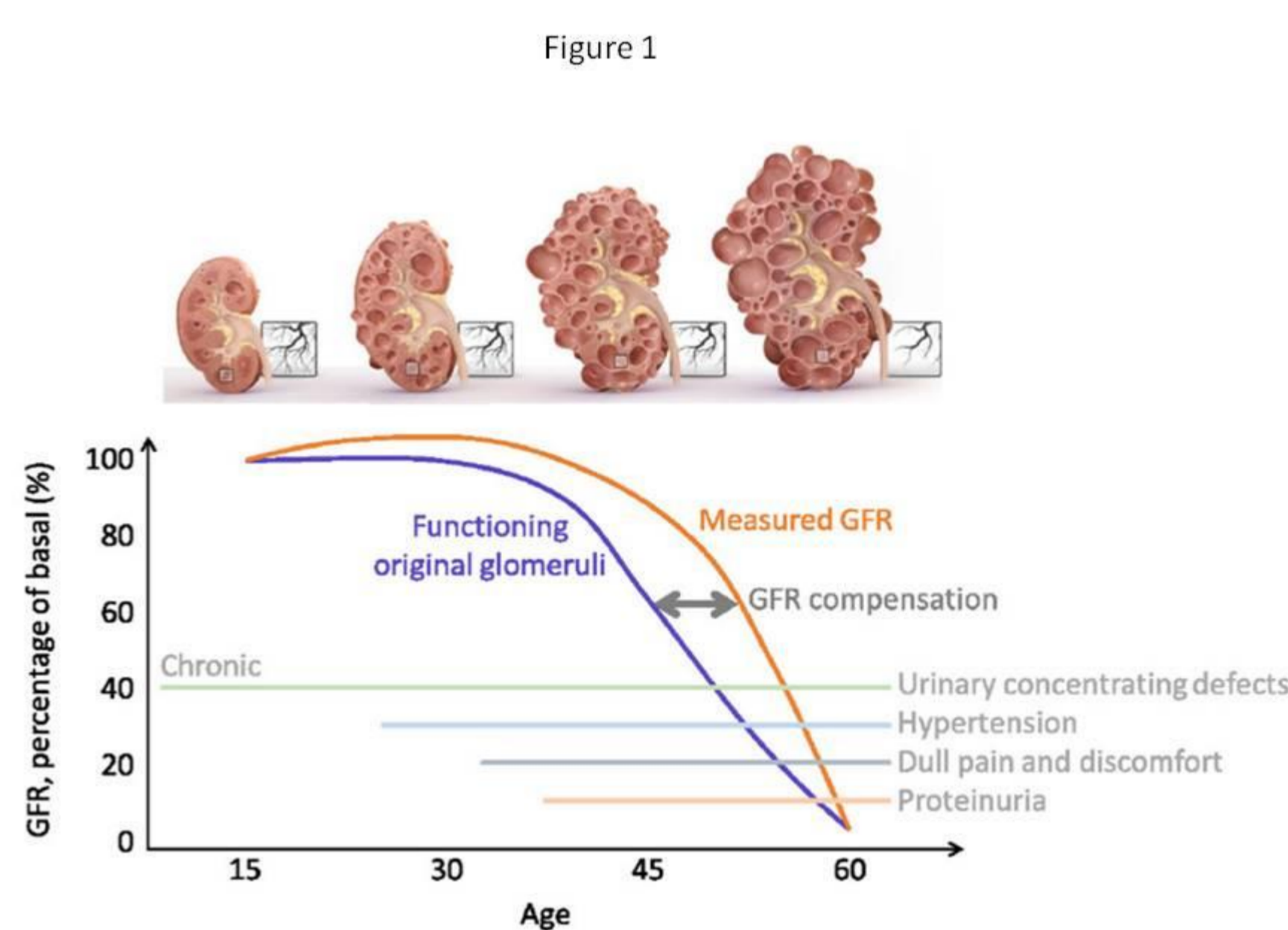
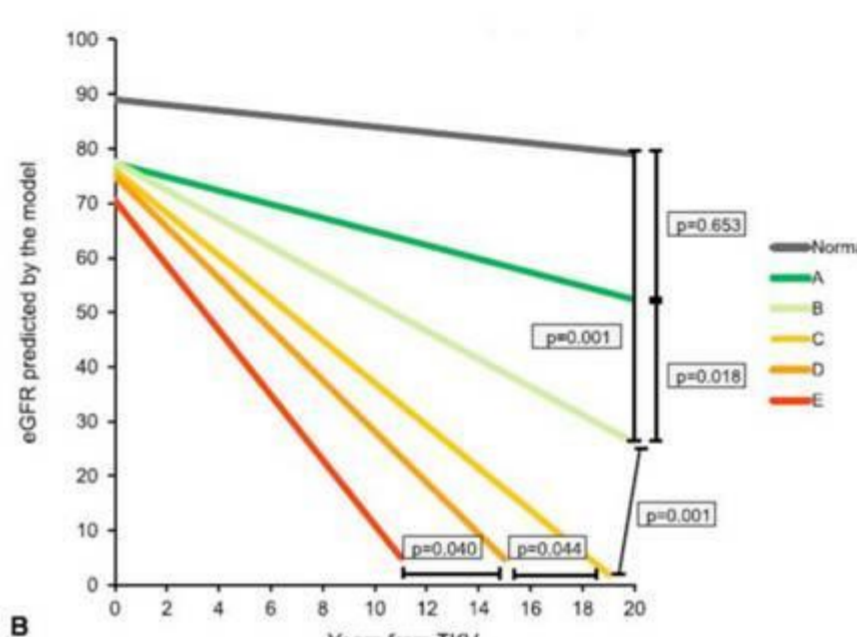
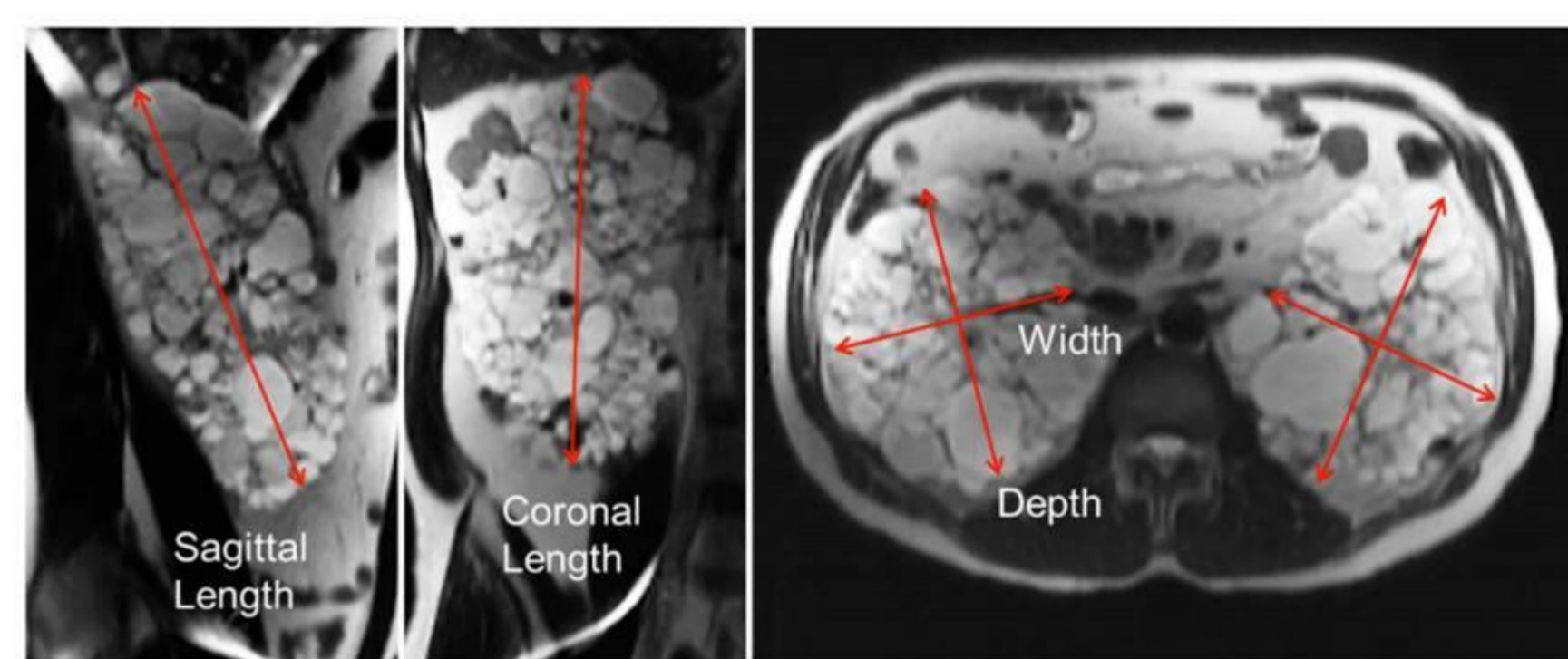


Figure 3



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CLASSES/n*	GFR>60	Hypertension/ HtTKV > 600	ESRD familiarity <55 years old
A/3	3	0	0
B/5	4	0	0
C/10	6	7	3
D/4	1	3	1
E/7	1	6	5

GFR	5 years CKD progression	10 years CKD progression
Pz with GFR > 60 ml/min	0	6/15 (stage 3 CKD)
Pz with GFR < 60 ml/min	6/14 (ESRD)	6/14 (ESRD) 2 (stage 4 CKD)