Microalbuminuria, proteinuria and renal function in children with cyanotic congenital heart disease

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Introduction

Cyanotic congenital heart diseases (CCHD) are recognized as a potential cause of *cyanotic nephropathy*. A long–lasting proteinuria can leads to kidney damage itself and so urinalysis should be a part of clinical assessment of each patient witch CHD. There have been few reports on changes in urinalysis *(proteinuria, albuminuria*) and impared renal function in patients with CCHD due to chronic reduced concentration of oxygen in systemic arteries and tissues. There are evidences of glomeruli enlargement in cyanosis.

Aim

The aim of this study was to estimate the albuminuria, proteinuria and *glomerular filtration rate* (GFR) in patients with CCHD in comparison to patients *with non-cyanotic congenital heart disease* (non-CCHD).

Methods

126 children with CHD hospitalized in Cardiology Clinic (Children's Memorial Health Institute) were examined. The exclusion criteria were any known kidney disease and urinary tract pathology (defect, infection, hipercalciuria, urolithasis, hypertension, diabetes). Patients were divided into non-CCHD group (Oxygen saturation (SaO2 above 90%), and CCHD group (SaO2 below 90%).

Each patient had evaluated:

- total protein/creatinine ratio (PCR)
- albumin/creatinine ratio (ACR) (in morning spot urine)
- GFR (calculated using the Schwartz formula

GFR = height x k/Cr)

Normal value of PCR is:
<0.2 (in children >2 y.o.), and <0.5 (in children <2 y.o.).
Albumin shouldn't be present in urine sample in healthy kidney in concentration above 20mg/l. We recognize the microalbuminuria when when ARC is in range 30-300 mcg/dl.
GFR under 90ml/min/1.73m^2 is definded as reduced.

The statistical significance of the differences in ARC, PCR and GFR was assessed by the U-Mann Whitney test.
The frequency of significant proteinuria, albuminuria and GFR were evaluated by Chi-square test.

	Type of CHD		Age	Sex	ACR (mcg/mg)	PCR (mg/mg)	GFR (ml/min/1.73)
Non-CCHD N= 67	ASD – 12 (3)* PDA – 8 (1)* VSD – 7 (4)* PS - 6 SA - 8 TOF – 6* TGA – 7*	AVSD – 3* APIVS – 3* ASD+VSD – 1* APVSD – 2* DORV – 1* TAPVD – 1* cTGA – 1	5.3 +/- 4.82 years	Girls – 30 Boys – 37	M=13.73 SD=11.6 Min=0.9 Max=30.7	M=0.25 SD=0.18 Min=0.04 Max=0.54	M=107.61 SD=24.90 Min=43.8 Max=171.2
CCHD N = 59	HLHS – 20 TOF - 7 APIVS - 6 AT - 5 APVSD - 6 DILV - 1	DORV - 5 TAC – 2 AVSD – 4 Ebstein Syndrome – 2 TGA – 1	3.9 +/- 2.97 years	Girls – 26 Boys - 33	M=132.7 SD=27.3 Min=4.1 Max=423	M=0.51 SD=0.28 Min=0.17 Max=2.21	M=101.18 SD=18.29 Min=37.2 Max=145.5

* - Surgically-corrected of CHD, M – Mean, SD – Standard Deviation

Table 1. Characteristic and desctription of groups

Results

The aggregate data for both groups, including types of congenital heart defects, is shown in table 1. The obtained results are presented in table 2 and charts.

PCR above the norm were observed in 11 children from non-CCHD group and 29 from CCHD group (16.4% vs 45.7%) (chi-square statistic is 8,79, p<0.003). We observe significantly higher PCR in patient from CCHD group than in patient from non-CCHD group, (U=1273.5, Z=-3.55427, p=0.00038).

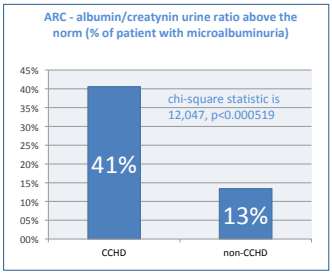
Microalbuminuria were observed in 9 children non-CCHD group and 24 children from CCHD group (13.4% vs 40.6%) (chi-square statistic is 12,047, p<0.000519). We also observe significantly higher ARC in patient from CCHD group than in patient from non-CCHD group (U=1598.5, Z=-1.98479, p=0.047).

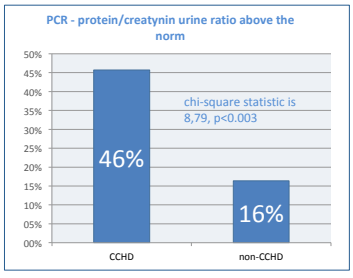
Reduced GFR (<90ml/min/1.73m^2) was observed in similar frequency in both groups: in 7 (10.4%) children without cyanosis (non-CCHD) and 9 (15%) children with cyanosis (CCHD) (chi-square statistic is 0,0696, p<0.7919). However patients with CCHD had significantly lower GFR values in comparison with non-CCHD patients (U=1639.5, Z=1.78679, p=0.0073), the mean GFR was still normal, above 90ml/min/1.73m^2).

AEPC 2018

	Group	n	Me	M	Mean Rang	U	Z	p
ACR	CCHD	59	11.61	132.7	70.86	1598.5	-1.98479	0,047
	Non-CCHD	67	7.73	13.73	57.86			
PCR	CCHD	59	0.28	0.51	76.28	1273.5	-3.554	0,00038
	Non-CCHD	67	0.17	0.25	53.01			
GFR	CCHD	59	102.34	101.18	57.82	1639.5	1.786	0,073
	Non-CCHD	67	108.79	107.61	64			

Table 2. U-Mann Withney test results: of ARC, PCR, and GFR





Charts: Frequency of microalbuminuria and significant proteinuria

Conclusion

- Cyanotic patient had higher ACR and PCR, and more frequent microalbuminuria and significant proteinuria.
- Although still in the normal range, GFR was significantly lower in patients with cyanosis.