Stanford Stamore Children's Health

Introduction

There has been an increase in the prevalence of cardiovascular risk factors (e.g., hypertension, diabetes mellitus, obesity, smoking, peripheral arterial disease, and chronic kidney disease) among adults with CHD. Diabetes mellitus (DM) is associated with atherosclerosis and is a major risk factor for poor prognosis in adults with cardiovascular disease. In the United States, about 1 in 5 adolescents and 1 in 4 young adults have prediabetes.

Little is known about DM risk in adolescents and young adults with Fontan circulation. We sought to understand the prevalence of abnormal hemoglobin A1c (HgA1c) in the adolescent and young adult population with Fontan palliation.

Methods

This is a single center retrospective study of Fontan patients seen in a pediatric multi-disciplinary single ventricle clinic. As part of our standard surveillance care, all patients ≥ 10 years of age undergo screening for DM with HgbA1c. Based on American Diabetes Association criteria, abnormal HgbA1c was defined as HgbA1c \geq 5.7% (pre-diabetes). Family history of DM in first-degree relatives was collected from chart review. Comparisons between groups were performed using chisquared and two-tailed T test.

Table 1. Dem

Age (years) Gender Male Female Race White Hispanic Asian African Ame Other HgA1c (%) BMI (percentil BMI Obese Overnight Family history DM Data are presented N (%)



High Prevalence of Abnormal HgA1c in the Adolescent and Young Adult Fontan Population

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ographics (N =66)		Table 2. Risk Factors			
	14.8 (12.6, 16.6)		Normal (HgA1c < 5.7%)	Prediabetes & Diabetes $(HgA1c \ge 5.7\%)$	p-value
	25 (38%)	BMI $\geq 85^{\text{th}}$ percentile	8 (27%)	10 (31%)	0.69
	× /	Family history of DM	5 (19%)	8 (21%)	0.85
	28 (44%)	Years from Fontan	12 (9,13)	10 (8, 12)	
rican	26 (41%) 4 (6%) 3 (5%) 3 (4%) 5.7 (5.5, 5.9)	Race (N=64) White Hispanic Asian African American	16 12 1 1	12 14 3 2	0.56
le)	49.6 (26.1, 87.7)	eGFR	98.7 (81.2, 117.4)	104.9 (97.1, 113.6)	0.62
		Hematocrit	45.3 (42.4, 48.1)	43.9 (42, 47.1)	0.45
	8 (13%) 10 (16%)	AST ALT	28.5 (23.75,32) 29 (22.75, 34.5)	29.5 (25.25, 35.5) 27 (23, 32.75)	0.09 0.46
of as med	13 (20%) ian (25 th , 75 th percentiles) or	Lipids Total Cholesterol HDL LDL Triglycerides	115 (106.5, 128.5) 43 (39.5, 49) 62 (47.5, 71.5) 71 (56.5, 89.5)	122 (114, 146) 42 (37, 49) 63 (55, 81) 72 (61, 83)	0.04 1.0 0.11 0.14

Data are presented as median (25^{th} , 75^{th} percentiles) or N (%)



Between 2015 and 2021, 78 Fontan patients >10 years of age were seen in our single ventricle clinic; 66 underwent screening with HgA1c (Table 1). 50% of the study cohort (n=33) had HgbA1c \geq 5.7%; 2% (n=1) had HgbA1c \geq 6.5% (Figure 1). There was no correlation between BMI and HgbA1c (Figure 2), with no difference in the prevalence of overweight or obesity $(BMI \ge 85^{th} percentile)$ between those with and without abnormal HbgA1c (31% versus 27%, p=0.69).

While 20% of the study cohort had a family history of DM, there was no difference in family history between those with and without abnormal HgbA1c (21% versus 19%, p=0.85). There were no differences in other traditional risk factors between those with and without normal HgbA1c (Table 2).

Over 50% of the adolescents and young adult Fontan palliated patients in our clinic had an abnormal HgA1c, and surprisingly, abnormal HgA1c did not correlate with traditional risk factors for DM. Our results highlight the importance of recognizing that abnormal HbA1c is highly prevalent in the Fontan population. Our results also demonstrate that abnormal HgA1c is can be detected in as early as adolescence.

Whether abnormal HgA1c in this unique population correlates with the development of atherosclerotic cardiovascular disease in adulthood is not known. Prior studies have suggested an association among metabolic syndrome, activation of the renin-angiotensin system, chronic liver disease, chronic kidney disease, and reduced muscle mass with impaired glucose tolerance in the adult Fontan population. The mechanism for an elevated and abnormal HgA1c in the adolescent and young adult Fontan population remains unclear and further studies looking at other factors such as impaired red blood cell clearance, impaired renal clearance from chronic kidney disease, decreased muscle mass, and chronic hypoxemia are needed.



Results

Conclusions