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BACKGROUND

- Iron deficiency (ID) is associated with morbidity and mortality in adults with heart failure (HF)
- There are limited data describing the prevalence and outcomes of ID in pediatric HF

HYPOTHESES

- ID is present in a majority (> 50%) of pediatric HF patients
- ID in pediatric HF patients is associated with greater morbidity and resource utilization
- ID in pediatric HF patients is associated with adverse outcomes of heart transplant (HTx), ventricular assist device (VAD) or death

METHODS

- A single center retrospective chart review from 2012 to 2017 including all patients with systolic HF aged 1-21y, with ID testing, without past HTx
- ID defined as ≥ 2 of the following: serum iron < 50 mcg/dL, ferritin < 20 ng/mL, transferrin > 300 mg/dL and transferrin saturation < 15%
- Outcomes:** composite adverse event (AE) of HTx, VAD or death at 3 and 6 months post-ID testing
- Patient outcomes analyzed in 3 groups: 1) cardiomyopathy, 2) congenital heart disease (CHD) with single ventricle physiology (SV) and HF, 3) CHD with two ventricle physiology (BiV) and HF
- Clinical features compared using Chi-square, Fisher’s exact for categorical variables and Wilcoxon Rank sum for continuous variables
- Multivariable outcome models created using binary logistic regression, including all variables with p < 0.2 on univariate analysis, and then backward elimination to only retain variables with p < 0.05, in addition to iron deficiency

RESULTS

- ID testing available for 45% of HF patients – 101 patients met final inclusion criteria
- DEMOGRAPHICS: 56% (57/101) male, 31% (31/101) non-Hispanic White, 44% (44/101) Hispanic
- 43% (43/101) iron deficient, 40% (40/101) anemic
- 42% (42/101) patients met AE by 3 months, and 51% (51/101) met AE by 6 months

COMPARISON OF CHARACTERISTICS OF ID AND NON-ID STUDY COHORT ¹			
CLINICAL FEATURE	No Iron Deficiency (n=43)	Iron Deficiency (n=58)	p-value
HF for ≥ 3months	21 (49)	25 (43)	0.567
Anemia, n (%)	11 (26)	29 (50)	0.016
Microcytosis, n (%)	1 (2)	8 (14)	0.070
Serum BNP (median, IQR)	986 (186 – 2110)	1950 (831 – 3198)	0.001
Elevated ALT, n (%)	26 (61)	43 (74)	0.151
Elevated AST, n (%)	22 (51)	33 (57)	0.605
Abnormal eGFR, n (%)	16 (37)	16 (28)	0.292
OUTCOMES			
AE at 3mo, n (%)	9 (21)	33 (57)	<0.001
AE at 6mo, n (%)	12 (28)	39 (67)	<0.001
Percentage Time Inpatient at 3mo (median, IQR)	13 (11 – 52)	93 (18 – 100)	<0.001
Percentage Time Inpatient at 6mo (median, IQR)	8 (1 – 41)	65 (13 – 100)	<0.001

1 - No significant difference in demographics (age, sex , race/ethnicity) or etiology of HF of patients with and without ID

GROUP 1. CARDIOMYOPATHY – UNIVARIATE AND MULTIVARIABLE ANALYSIS OF PRIMARY OUTCOMES (n = 58)										
	3 MONTHS FOLLOW UP					6 MONTHS FOLLOW UP				
	No AE (n=30)	AE (n=26)	p-value uni	p-value multi [#]	OR (95% CI) [#]	No AE (n=27)	AE (n=29)	p-value uni	p-value multi [#]	OR (95% CI) [#]
Iron Deficiency, n (%)	13 (43)	22 (85)	0.001 ^{\$}	0.005[#]	6.78 (1.77 – 26.01)	11 (41)	24 (83)	0.001 ^{\$}	0.026[#]	4.47 (1.20 – 16.68)
HF for ≥3months, n (%)	17 (56)	6 (23)	0.011 ^{\$}	0.030 [#]	0.25 (0.07 – 0.88)	15 (56)	8 (30)	0.034 ^{\$}		
Anemia, n (%)	15 (50)	15 (58)	0.657			14 (52)	16 (55)	0.921		
BNP (median, IQR)	896 (464 – 2563)	2434 (1319 – 3253)	0.001 ^{\$}			824 (315 – 2791)	2181 (1038 – 3217)	0.003 ^{\$}	0.025 [#]	4.13 (1.20 – 14.28)
Elevated ALT, n (%)	20 (67)	21 (81)	0.235			18 (67)	23 (79)	0.286		
Elevated AST, n (%)	15 (50)	16 (62)	0.386			12 (44)	19 (66)	0.113 ^{\$}		
Decreased eGFR, n (%)	11 (37)	5 (19)	0.175 ^{\$}			10 (37)	6 (21)	0.203		

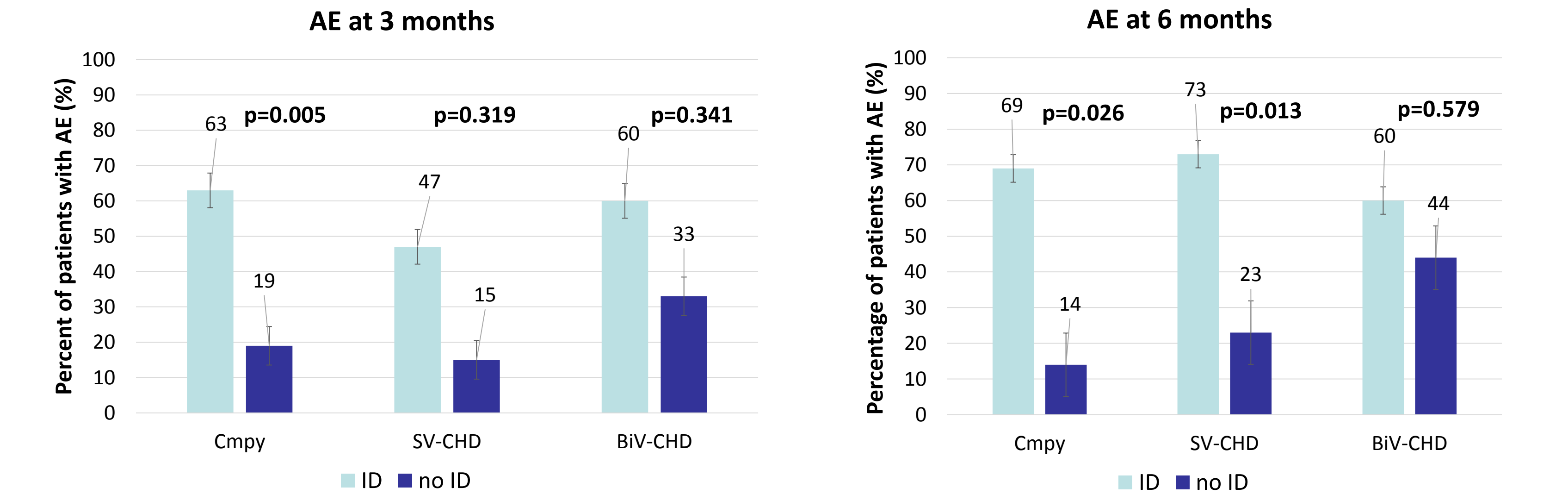
\$ - Variables in initial multivariable model; # - Variables remaining in final multivariable model

GROUP 2. SINGLE VENTRICLE CHD – UNIVARIATE AND MULTIVARIABLE ANALYSIS OF PRIMARY OUTCOMES (n = 28)										
	3 MONTHS FOLLOW UP					6 MONTHS FOLLOW UP				
	No AE (n=19)	AE (n=9)	p-value uni	p-value multi	OR (95% CI)	No AE (n=14)	AE (n=14)	p-value uni	p-value multi [#]	OR (95% CI) [#]
Iron Deficiency, n (%)	8 (42)	7 (78)	0.114 ^{\$}	0.319 [#]	2.97 (0.35 – 25.23)	4 (29)	11 (79)	0.008 ^{\$}	0.013[#]	19.51 (1.86 – 205.16)
HF for ≥3months, n (%)	11 (58)	6 (67)	1.00			6 (43)	11 (79)	0.053 ^{\$}	0.042 [#]	12.03 (1.09 – 132.28)
Anemia, n (%)	0 (0)	1 (11)	0.321			0 (0)	1 (7)	1.00		
BNP (median, IQR)	676 (131 – 2104)	2719 (1607 – 6286)	0.011 ^{\$}	0.029 [#]	14.17 (1.31 – 153.1)	550 (76 – 1933)	2080 (1000 – 2987)	0.027 ^{\$}		
Elevated ALT, n (%)	12 (63)	7 (78)	1.00			9 (64)	10 (71)	1.00		
Elevated AST, n (%)	10 (53)	6 (67)	1.00			7 (50)	9 (64)	1.00		
Decreased eGFR, n (%)	11 (37)	5 (19)	0.175 ^{\$}			6 (43)	5 (36)	0.699		

\$ - Variables in initial multivariable model; # - Variables remaining in final multivariable model (exploratory in nature due to limited number of outcomes)

- Group 3. TWO-VENTRICLE CHD (n = 14):** ID was not significantly associated with AE at 3 months (p = 0.341) or at 6 months (p = 0.579)

COMPARISON OF RATE OF AE BETWEEN ID AND NON-ID COHORTS BY ETIOLOGY OF HF



CONCLUSIONS

- A majority of pediatric HF patients have ID
- Microcytosis is not a reliable marker of ID in pediatric HF patients
- ID is associated with greater percentage of time spent hospitalized during the follow up period
- ID is associated with increased chance of an AE of VAD, HTx, or death in pediatric HF patients with cardiomyopathy or SV-CHD