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ORIGINAL RESEARCH

Association of Body Mass Index With Clinical Features and Outcomes in Adults With Fontan Palliation

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BACKGROUND: With improving survival of patients with single ventricle physiology who underwent Fontan palliation, there is also an increase in the prevalence of overweight and obesity in these patients. This tertiary care single-center study aims to determine the association of body mass index (BMI) with the clinical characteristics and outcomes in adults with Fontan.

METHODS AND RESULTS: Adult patients (aged ≥18 years) with Fontan who were managed at a single tertiary care center between January 1, 2000, and July 1, 2019, and had BMI data available were identified via retrospective review of medical records. Univariate and multivariable (after adjusting for age, sex, functional class, and type of Fontan) linear and logistic regression, as appropriate, were utilized to evaluate associations between BMI and diagnostic testing and clinical outcomes. A total of 163 adult patients with Fontan were included (mean age, 29.9±9.08 years), with a mean BMI of 24.2±5.21 kg/m^2 (37.4% of patients had BMI ≥25 kg/m^2). Echocardiography data were available for 95.7% of patients, exercise testing for 39.3% of patients, and catheterization for 53.7% of patients. Each SD increase in BMI was significantly associated with decreased peak oxygen consumption (P=0.010) on univariate analysis and with increased Fontan pressure (P=0.035) and pulmonary capillary wedge pressure (P=0.037) on multivariable analysis. In addition, BMI ≥25 kg/m^2 was independently associated with heart failure hospitalization (adjusted odds ratio [AOR], 10.2; 95% CI, 2.79–37.1 [P<0.001]) and thromboembolic complications (AOR, 2.79; 95% CI, 1.11–6.97 [P=0.029]).

CONCLUSIONS: Elevated BMI is associated with poor hemodynamics and worse clinical outcomes in adult patients with Fontan. Whether elevated BMI is the cause or consequence of poor clinical outcomes needs to be further established.

Key Words: body mass index ■ exercise intolerance ■ Fontan palliation ■ heart failure ■ outcomes

First described in 1971, the Fontan procedure is a palliative operation for patients with complex single ventricle physiology and utilizes the single ventricle to pump blood into the systemic circulation. Advancements in surgical technique and medical care have led to a growing number of patients with Fontan reaching adulthood.[1] As the number of patients with Fontan has increased, so too has the prevalence of overweight and obese patients with this condition.[2–4] Decades of research have demonstrated increased cardiovascular morbidity and mortality in overweight populations, but knowledge on the impact of elevated body mass index (BMI) on the clinical profile of adults with Fontan palliation remains limited.[5]

Fontan circulation is characterized by chronically elevated central venous and hepatic pressures that is ultimately associated with several cardiac

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CLINICAL PERSPECTIVES

What Is New?

- Among adults with Fontan palliation, elevated body mass index is independently associated with elevated Fontan pressure, left-sided filling pressures, heart failure hospitalization, and thromboembolic complications after adjusting for age, sex, functional class, and type of Fontan palliation.

What Are the Clinical Implications?

- Our data underscore the importance of screening and managing modifiable risk factors, such as body mass index, to potentially risk stratify and alter outcomes of the growing population of adults with Fontan palliation.

Nonstandard Abbreviations and Acronyms

CPET	cardiopulmonary exercise testing
NYHA	New York Health Association
O_2	oxygen
PCWP	pulmonary capillary wedge pressure
TEC	thromboembolic complication
UCSF	University of California, San Francisco
V_E	minute ventilation
VO_2	oxygen consumption

and noncardiac consequences.[1] Prior studies have identified various long-term sequelae of the Fontan procedure, including arrythmias, heart failure (HF), thromboembolic events, cirrhosis, protein-losing enteropathy, and death.[6–10] Researchers have previously identified several risk factors associated with these adverse cardiovascular events. However, these factors are mainly nonmodifiable, including preoperative conditions, type of operation, and timing of the procedure.[6] Nationally, there has been a growing interest in the role that modifiable risk factors, such as obesity and physical activity, can play for various cardiovascular conditions.[11,12] Modifiable risk factors account for high rates of variability within acquired cardiovascular conditions, but there remains a significant knowledge gap on the relationship between modifiable risk factors and outcomes in congenital cardiovascular conditions. Current guidelines recommend that patients with Fontan palliation follow a healthy lifestyle and prevent obesity because of the risk of metabolic syndrome and associated sequalae.[13] Further understanding of the association between elevated BMI and Fontan-related morbidity will provide important information to clinicians about managing this complex patient population.

We thus performed a retrospective study of adults with Fontan palliation at our institution to determine the association of BMI on their clinical characteristics and outcomes. We hypothesized that elevated BMI would be associated with an increased prevalence of adverse outcomes in adult survivors of Fontan palliation.

METHODS

In this retrospective cross-sectional study, all adult (aged ≥18 years) survivors of single ventricle physiology who had undergone Fontan procedure and were managed during adulthood at the University of California San Francisco's (UCSF's) multidisciplinary congenital heart disease program between January 1, 2000, and July 1, 2019, were identified from electronic health records. The institutional review board of UCSF approved this study with a waiver of consent. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Data were extracted from the electronic health record and included demographic information, operative reports, clinical profiles, diagnostic testing, and clinical outcomes. All of the diagnostic studies were performed as a part of the routine clinical evaluation of patients at our institution. Baseline demographic information included age, sex, and race or ethnicity. Information about surgical details such as a central shunt placement, fenestration, and the type of Fontan (atriopulmonary, lateral tunnel, or extracardiac) were obtained through electronic health record notes and operative reports. Patients were included in the fenestration group if they had a fenestrated Fontan conduit at any time, irrespective of whether the fenestration was subsequently closed or not. Other medical history data such as the time since Fontan and the systemic ventricular morphology (left or right) were extracted. Data about the New York Heart Association (NYHA) class were obtained through chart review. Anthropomorphic data including weight (kg) and height (cm) from the last follow-up clinic note were used to calculate the BMI (kg/m^2). Aspirin or anticoagulant use was also extracted from the last clinic note.

Laboratory and other diagnostic data from the most recent evaluation during the study period were collected. Results from transthoracic echocardiography, cardiopulmonary exercise testing (CPET), and cardiac catheterization were extracted. Echocardiographic study reports were used to determine whether there was any systemic ventricular dysfunction and to determine the degree of atrioventricular valve dysfunction. CPET studies were performed per institutional protocol as described in our previous study.[14] CPET data were extracted to include metabolic equivalents, peak heart rate, peak heart rate percent predicted, peak oxygen consumption (VO_2), peak VO_2 percent predicted, peak oxygen (O_2) pulse, peak O_2 pulse percent predicted, and minute ventilation (V_E)/carbon dioxide production slope.[14] Cardiac catheterization data were collected to include Fontan pressure, pulmonary capillary wedge pressure (PCWP), pulmonary vascular resistance, and cardiac output.

Adverse clinical outcomes were defined as any of the following: arrhythmia, pacemaker/implantable cardioverter-defibrillator placement, liver cirrhosis, protein-losing enteropathy, HF hospitalization, or thromboembolic complication (TEC) at any point after the Fontan palliation or death. Arrhythmias were defined as any clinically significant impairment of rhythm or conduction based on available ECG records and ambulatory monitor recording, need for antiarrhythmic drug therapy, pacemaker placement, or cardioversion.[6] Patients were characterized as having cirrhosis if there was imaging evidence of cirrhosis, with or without portal hypertension, splenomegaly, ascites, or varices.[14] Protein-losing enteropathy was determined based on low serum total protein/albumin and persistent or intermittent edema or documentation of enteric loss of α_1-antitrypsin.[6] HF hospitalization was defined as hospitalization for worsening symptoms of HF that required intravenous diuretic therapy.[13] TECs were defined as intracardiac thrombus, ischemic stroke, systemic arterial embolus, Fontan conduit/right atrial thrombus, or pulmonary embolus as identified through imaging. Mortality data were obtained from the electronic health record.

Statistical Analysis

Categorical variables are presented as frequencies and percentages. Continuous variables are presented as the mean with SD or median (interquartile range) as appropriate. Fisher exact test was utilized to compare categorical variables and Kruskal-Wallis test for continuous variables. Continuous BMI was scaled by subtracting mean and dividing by the SD to report change in outcomes for each SD change in BMI. Univariate and multivariable linear regression was performed to estimate the association between standardized BMI and CPET and cardiac catheterization variables. Univariate and multivariable logistic regression was performed to examine the association between BMI and clinical outcomes. All regression models were performed using restricted cubic splines with 3 knots of the continuous variables (standardized BMI and age) to adjust for residual confounding. Goodness of fit was checked for all models. R^2 values of the linear regression models are reported. Based on the Hosmer-Lemeshow goodness-of-fit test, we did not find evidence of lack of fit for any of the logistic regression models (P>0.05). In some cases, the fit was not improved by the cubic splines. These were typically cases with no association. We used them primarily as a descriptive rather than as a predictive tool. All analyses were considered significant if they had a 2-tailed probability value of <0.05. All statistical analyses were conducted using the Stata program Stata/IC version 16.0 and 17.0 (StataCorp LLC).

RESULTS

Baseline Characteristics

Of the 190 adults with Fontan palliation managed at UCSF during the study period, 27 were excluded because of missing BMI data. The final cohort included 163 patients: 97 (59.9%) had extracardiac, 43 (26.5%) had lateral tunnel, and 22 (13.6%) had atriopulmonary Fontan circulation. Underlying cardiac lesions included tricuspid atresia (58 [35.6%]), double-inlet left ventricle (33 [20.3%]), hypoplastic left heart syndrome (30 [18.4%]), double-outlet right ventricle (13 [7.98%]), pulmonary atresia with intact ventricular septum (9 [5.52%]), hypoplastic right heart syndrome (5 [3.07%]), transposition of great arteries (4 [2.45%]), pulmonary atresia (2 [1.22%]), Ebstein anomaly (1 [0.61%]), and heterotaxy (8 [4.91%]).

The mean (SD) follow-up time since the Fontan completion was 28.1±9.57 years. The mean age of the study population was 29.9±9.08 years, and 84 (51.5%) were women. The mean age at the time of Fontan palliation was 6.62±7.03 years. The mean BMI of all patients was 24.2±5.21 kg/m^2, and 61 (37.4%) had a BMI ≥25 kg/m^2 while 17 (10.4%) had a BMI <18.5 kg/m^2. Compared with those with BMI <25 kg/m^2, patients with BMI ≥25 kg/m^2 were older and had a higher prevalence of depression/anxiety (Table 1).

Diagnostic Testing and BMI

Echocardiography results were available for 156 (95.7%), CPET for 64 (39.3%), and cardiac catheterization for 87 (53.7%) patients. There were no significant differences in the echocardiographic variables between those with or without elevated BMI (Table 2). Patients with BMI ≥25 kg/m^2 had significantly lower peak VO_2, higher Fontan pressures, and higher PCWP than those with BMI <25 kg/m^2 (Table 2).

On univariate linear regression analysis, each SD increase in BMI was associated with a significant decrease in peak VO_2 and increase in Fontan pressure and PCWP. After adjusting for patients' age, sex, NYHA class ≥II, and type of Fontan, each SD increase in BMI was independently associated with an increase in Fontan pressure and PCWP (Figure 1).

Adverse Outcomes and BMI

Data about liver cirrhosis were available for 95 patients. A total of 106 (65.0%) patients were noted to have had

Table 1. Baseline Clinical Characteristics

	All patients (N=163)	BMI ≥25 kg/m^2 (n=61)	BMI <25 kg/m^2 (n=102)	*P* value
Age at Fontan, y	6.62±7.03	8.24±8.76	5.71±5.71	0.128
Current age, y	29.9±9.08	31.9±9.65	28.7±8.55	0.028
Average follow-up, y	28.1±9.57	31.2±9.73	26.2±9.01	0.001
Women	84 (51.5)	33 (54.1)	51 (50.0)	0.612
Race or ethnicity				
Black	6 (3.68)	4 (6.56)	2 (1.96)	0.407
Asian	14 (8.59)	4 (6.56)	10 (9.80)	
White	87 (53.4)	29 (47.5)	58 (56.9)	
Hispanic	44 (27.0)	19 (31.2)	25 (24.5)	
Other	12 (7.36)	5 (8.20)	7 (6.86)	
Type of Fontan (n=162)				
Atriopulmonary	22 (13.6)	7 (11.7)	15 (14.7)	0.766
Lateral tunnel	43 (26.5)	15 (25.0)	28 (27.5)	
Extracardiac	97 (59.9)	38 (63.3)	59 (57.8)	
Fenestration	62 (38.0)	22 (36.1)	40 (39.2)	0.688
Systemic right ventricle (n=156)	43 (26.4)	19 (31.2)	24 (23.5)	0.286
Anxiety/depression (n=161)	70 (43.5)	35 (57.4)	35 (35.0)	0.005
NYHA class (n=155)				
NYHA class I	81 (52.3)	26 (43.3)	55 (57.9)	0.361
NYHA class II	39 (25.2)	18 (30.0)	21 (22.1)	
NYHA class III/IV	35 (22.6%)	16 (26.7)	19 (20.0)	
Warfarin or NOAC (n=158)	49 (31.0)	20 (33.3)	29 (29.6)	0.622
Aspirin (n=138)	99 (71.7)	38 (74.5)	61 (70.1)	0.580

All values represent mean±SD or number (percentage).
BMI indicates body mass index; NOAC, novel oral anticoagulant; and NYHA, New York Heart Association.

an adverse clinical outcome. Compared with those with BMI <25 kg/m^2, those with BMI ≥25 kg/m^2 were more likely to have had an HF hospitalization or TEC, after adjusting for age, sex, NYHA class ≥II, and type of Fontan (Figure 2).

DISCUSSION

Our study of 163 adult patients with Fontan at a tertiary center demonstrates the association of elevated BMI with unfavorable hemodynamics and adverse clinical outcomes. One in 3 patients with Fontan had a BMI ≥25 kg/m^2. An increase in BMI was associated with significantly lower exercise capacity and, after adjusting for covariates, with higher Fontan and wedge pressures. Compared with those with a BMI <25 kg/m^2, adult patients with Fontan who had a BMI ≥25 kg/m^2 had a higher prevalence of HF hospitalization and TECs. Prior studies have shown high prevalence of metabolic syndrome in adults with congenital heart disease[15] and have demonstrated an association of obesity with Fontan failure and HF.[16] In this study, we further enhance our understanding of the association of elevated BMI with hemodynamic variables and clinical outcomes among adults with Fontan palliation. Our finding of elevated BMI as a potential marker for abnormal hemodynamics and outcomes underscores the importance of appropriate risk monitoring and modification to be considered by the clinicians caring for patients with a single ventricle after Fontan palliation.

Our finding of a prevalence of 37% of patients in this population with a BMI ≥25 kg/m^2 is similar to what has been previously reported among adult patients with Fontan[16] and to the rates observed in the young adult population.[17] Children with single ventricle physiology are typically growth restricted in height and weight and have decreased functional capacity.[18] After palliation, there is a period of catch-up growth combined with decreased physical activity, which can contribute to excess weight gain in adulthood.[3,19] This trend toward increasing weight has been reported regardless of the underlying cause of the single ventricle or type of Fontan operation. This highlights the importance of routine monitoring for weight gain and interventions for risk reduction starting in the pediatric clinic for these patients.

Body composition of patients with a Fontan circulation is characterized by reduced skeletal muscle mass and increased adiposity, which impairs their peak

Table 2. Comparison of Diagnostic Testing Findings

	Overall (N=163)	BMI ≥25 kg/m^2 (n=61)	BMI <25 kg/m^2 (n=102)	*P* value
Echocardiogram data	**n=156**	**n=59**	**n=97**	
Systemic ventricular EF, %	57.7±13.5	57.8±11.4	57.6±14.5	0.469
Any systemic ventricular dysfunction	22 (14.5)	9 (15.5)	13 (13.8)	0.774
Moderate or severe atrioventricular valve regurgitation	29 (19.3)	11 (18.6)	18 (19.8)	0.863
CPET data	**n=64**	**n=25**	**n=39**	
METS	11.4±4.05	12.3±4.22	10.9±3.99	0.329
Peak heart rate	147±25.4	150±18.9	145±29.1	0.605
Peak heart rate % predicted	76.1±12.4	76.8±10.9	75.6±13.5	0.083
Peak VO_2	22.3±6.08	20.3±4.78	23.5±6.54	0.051
Peak VO_2% predicted	52.7±17.1	51.9±14.1	53.3±19.1	0.965
Peak O_2 pulse	10.2±2.80	10.6±2.75	9.87±2.82	0.325
Peak O_2 pulse % predicted	85.8±21.5	81.5±4.95	86.8±23.9	<0.999
V_E/VCO_2	32.6±6.10	33.1±6.43	32.2±5.93	0.589
Catheterization data	**n=87**	**n=38**	**n=49**	
Fontan pressure	14.0±4.05	14.9±3.49	13.3±4.36	0.023
PCWP	10.6±3.73	11.6±4.04	9.74±3.30	0.050
PVR	0.97±1.26	1.04±1.52	0.92±1.02	0.686
CO	5.01±1.61	5.17±1.43	4.88±1.75	0.217

All values represent mean ± SD or number (percentage).

BMI indicates body mass index; CPET, cardiopulmonary exercise testing; EF, ejection fraction; METS, metabolic equivalents; VO_2, oxygen consumption; O_2, oxygen; V_E/VCO2, minute ventilation/carbon dioxide production slope; PCWP, pulmonary capillary wedge pressure; PVR, pulmonary vascular resistance; and CO, cardiac output.

exercise capacity.[20,21] This explains our and prior investigators' findings of the association of lower VO_2 with increasing BMI among our study patients.[22] However, the lack of this association after adjusting for the covariates underscores the impact of other factors (such as age, sex, NYHA class, or type of Fontan) on VO_2 in these patients. Nevertheless, it is well established that a low level of VO_2 is an independent risk factor for cardiovascular mortality[23,24] and, hence, measures to improve this may improve clinical outcomes in patients. Moderate to vigorous exercise training, with a focus on resistance muscle training, has been shown to improve cardiac function and functional capacity in patients with Fontan.[25,26] Given this, exercise prescriptions should be highly encouraged during routine clinic visits.[27]

We observed that elevated BMI was associated with variables that suggest Fontan failure or HF in these patients, such as higher Fontan pressure, higher PCWP, and HF hospitalizations. Prior work from Martinez et al[16] similarly reported the association between obesity and symptomatic HF and mortality. This raises a possibility that in addition to being a modifiable risk factor to improve exercise tolerance and outcomes, elevated BMI in the Fontan population could also be a marker of underlying worsening hemodynamics. Researchers have shown that obesity can lead to an increase in total blood volume, stroke volume, and cardiac output and is associated with structural changes in the heart that have adverse effects on cardiovascular hemodynamics.[28,29] Elevated BMI is also associated with worse left ventricular diastolic function, which may lead to elevated filling pressures.[30,31] Single ventricles are exposed to volume overload at least until stage 2 palliation, which can lead to pathological ventricular remodeling. After completion of palliation, the systemic and pulmonary vascular beds are in series, resulting in chronic elevations in venous pressure and increased afterload, and the Fontan circulation remains dependent on passive blood flow. Any form of volume overload due to atrioventricular regurgitation, shunts, or other causes can worsen ventricular hemodynamics and lead to the development of HF and Fontan failure.[32–34] It is unclear in our study, however, whether elevated BMI was a consequence of Fontan failure or a cause of HF hospitalization. It is likely that the impact of elevated BMI on cardiovascular outcomes is amplified in the hemodynamics of the Fontan population, as single ventricle physiology is particularly susceptible to increased afterload and increased ventricular mass.

Unique to this study, although not surprising, was the 2.8-fold higher odds of TECs among patients with

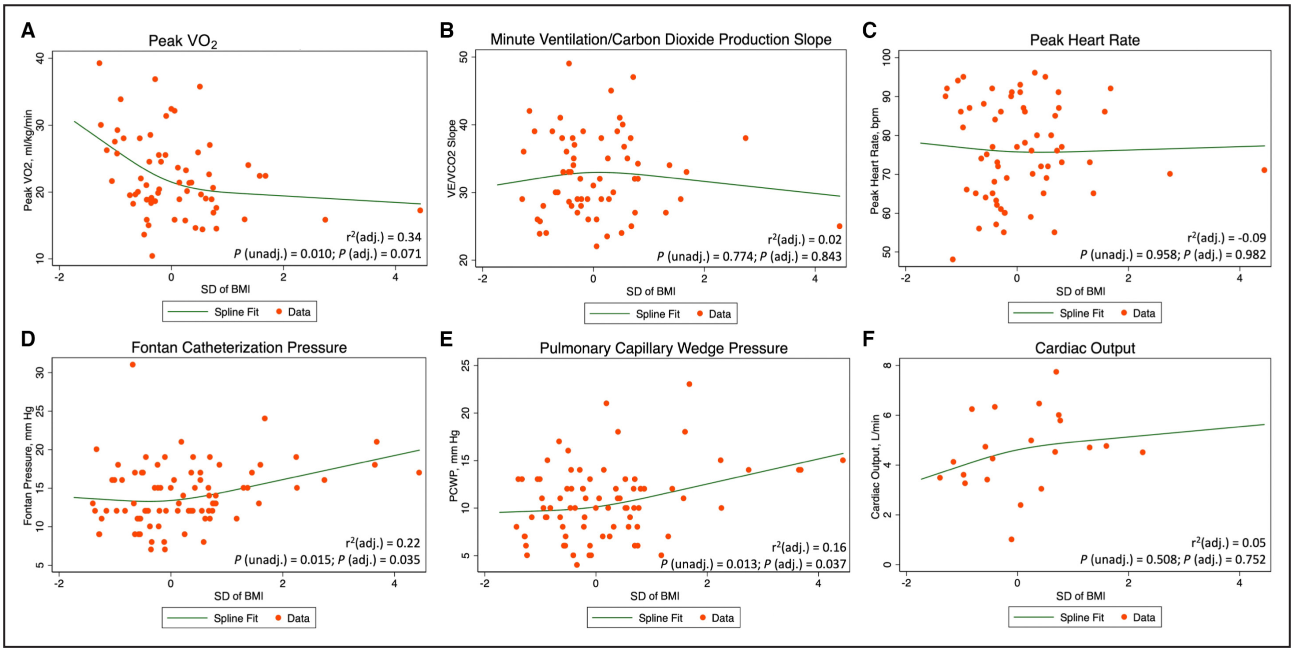
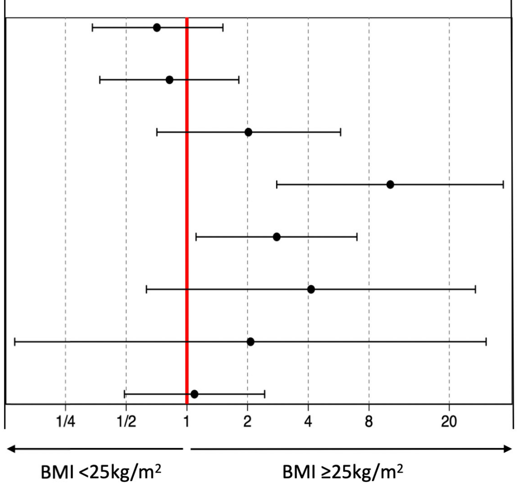


Figure 1. Changes in SD of BMI with variables on cardiac diagnostic testing.
The data are presented using restricted cubic splines of the SD of BMI (green line) and the scatter plot of actual data (red dots). VO_2, oxygen consumption; bpm, beats per minute; r^2 (adj), adjusted R^2 for multivariable regression model; *P* (unadj), *P* value for univariate linear regression; *P* (adj), *P* value for multivariable linear regression (after adjusting for restricted cubic spline of current age, sex, New York Heart Association class ≥II, and type of Fontan); BMI, body mass index.

elevated BMI, even after adjusting for age, NYHA class ≥II, sex, and type of Fontan. Obesity is an established risk factor for thrombosis and has been well studied with deep venous thrombosis.[35] Obesity is a systemic inflammatory condition, and the chronic inflammatory state can activate prothrombotic signaling.[36] Patients with Fontan have a higher prevalence of TEC than the general population, and the predominant predisposing factors are stasis of blood flow, prosthetic material, or atrial arrhythmias.[37] The higher Fontan filling pressures



Clinical Outcomes	BMI ≥25kg/m² n=61	BMI <25kg/m² n=102	AOR (95% CI)	*P* value
Arrhythmia	28 (45.9%)	49 (48.0%)	0.71 (0.34–1.51)	0.374
PPM/ICD	19 (31.7%)	30 (30.0%)	0.82 (0.37–1.81)	0.616
Cirrhosis	18 (42.9%)	14 (26.4%)	2.02 (0.71–5.78)	0.190
HF Hospitalization	16 (26.2%)	4 (3.92%)	10.2 (2.79–37.1)	<0.001
TEC	16 (26.2%)	12 (11.8%)	2.79 (1.11–6.97)	0.029
PLE	5 (8.20%)	2 (1.96%)	4.13 (0.63–27.0)	0.139
Death	3 (4.92%)	1 (0.99%)	2.07 (0.14–30.5)	0.596
Any event	43 (70.5%)	63 (61.8%)	1.09 (0.49–2.43)	0.827

Figure 2. Association of elevated BMI with adverse clinical outcomes.
Multivariable logistic regression was used to adjust for BMI ≥25 kg/m², restricted cubic spline of current age, sex, New York Heart Association class ≥II, and type of Fontan. AOR, adjusted odds ratio; BMI, body mass index; HF, PPM/ICD, pacemaker/implantable cardioverter-defibrillator; HF, heart failure; TEC, thromboembolic complications; and PLE, protein-losing enteropathy.

seen with elevated BMI may contribute to stasis, which could, in turn, lead to more thrombosis. This could potentially amplify the thrombogenic risks associated with obesity in the Fontan population. Future studies will be needed to evaluate TEC and the change in hemodynamic pressures to further evaluate this phenomenon.

We also found that patients with an elevated BMI had a higher prevalence of anxiety and depression. In a multinational study of patients with congenital heart disease, the Fontan population reported a poorer quality of life and a higher incidence of anxiety and depression when compared with patients with simple congenital heart diseases.[38] There is evidence that metabolic syndrome is more prevalent in patients with psychiatric illnesses, including anxiety and depression.[39] Contributory mechanisms include poor dietary choices, more sedentary lifestyle, and medication noncompliance, which may all lead to elevated BMI. Although our study does not show any causal relationship, it points to an important area where more research is needed, and early intervention has the potential to make an impact.

Elevated BMI and subsequent obesity are growing public health concerns. Elevated BMI is one of the key modifiable risk factors to target in terms of improving cardiovascular health. Our study and work from prior authors have shown that, in a population with Fontan, increasing prevalence of weight gain and obesity could have some significant hemodynamic and clinical consequences. Given our findings, we suspect that elevated BMI is a consequence of higher filling pressures, worsening hemodynamics, and adverse outcomes, and a contributor to poor functional status in the adult population with Fontan. Further studies will be needed to fully evaluate this association and to evaluate the impact of reduction in BMI on these outcomes or vice versa.

Limitations

Our study was conducted at a single tertiary care center and thus may include regional bias in the analysis, limiting generalization. In addition, the retrospective observational nature of the study has inherent limitations. We were unable to determine the causal relationship of elevated BMI and poor hemodynamics or clinical outcomes. In particular, we were unable to determine whether the weight component of BMI in our patients was caused by fluid retention or obesity, thus limiting our ability to conclude whether BMI was a modifiable risk factor versus a marker of underlying worsening hemodynamics in adults with Fontan. Despite this, this study's primary strength is its focus on an underresearched area with important clinical implications. Future prospective studies with serial BMI measurements might be helpful to determine this further. Cardiac catheterization and CPET data were available in ≤50% of our study patients, hence rendering a relatively smaller sample size. Despite this, we were able to identify strong associations between BMI and these variables.

CONCLUSIONS

In this tertiary care center experience of adults with Fontan palliation, elevated BMI was significantly associated with poor hemodynamics such as higher Fontan and filling pressures and poor clinical outcomes such as HF hospitalization and TECs. This suggests that elevated BMI could be a consequence of poor outcomes among adults with Fontan palliation but needs to be further established in prospective cohort studies. Future studies are needed to determine whether the adverse clinical outcomes are reversible after either the prevention or the treatment of overweight/obesity in this population. Clinicians managing this complex group of patients should be vigilant about this association because it could impact their evaluation and management of adults with Fontan palliation.

ARTICLE INFORMATION

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