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THE PRESENT AND FUTURE

STATE-OF-THE-ART REVIEW

Obesity and Atrial Fibrillation Prevalence, Pathogenesis, and Prognosis

Effects of Weight Loss and Exercise

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ABSTRACT

Both obesity and atrial fibrillation (AF) are increasing in epidemic proportions, and both increase the prevalence of cardiovascular disease events. Obesity has adverse effects on cardiovascular hemodynamics and cardiac structure and function, and increases the prevalence of AF, partly related to electroanatomic remodeling in obese patients. However, numerous studies, including in AF, have demonstrated an obesity paradox, where overweight and obese patients with these disorders have a better prognosis than do leaner patients with the same degree of severity of cardiovascular disease/AF. In this paper, the authors discuss special issues regarding AF in obesity, as well as the evidence that despite the presence of an obesity paradox, there are benefits of weight loss, physical activity/exercise training, and increases in cardiorespiratory fitness on the prognosis of obese patients with AF. (J Am Coll Cardiol 2017;70:2022–35)

Obesity has been increasing in epidemic proportions in the United States and in most of the Westernized world. The prevalence of obesity (based on body mass index [BMI] ≥30 kg/m^2) in U.S. adults from 2013 to 2014 is 38%, and with Class III obesity (BMI ≥40 kg/m^2) approaches 8% (1). Considering the adverse effects that obesity has on cardiovascular hemodynamics and cardiovascular structure and function, not surprisingly, almost all cardiovascular diseases (CVDs) increase in frequency in the setting of obesity, including hypertension, coronary heart disease (CHD), heart failure (HF), and atrial fibrillation (AF) (2,3). However, in most CVDs, an obesity paradox has been demonstrated, where overweight (BMI 25.0 to 29.9 kg/m^2) and those with mild obesity (BMI 30.0 to 34.9 kg/m^2) have a better prognosis than do underweight persons (BMI ≤18.5 kg/m^2) and those with "normal" weight (BMI 18.5 to 24.9 kg/m^2) (2,3).

Although AF is already considered the most common sustained arrhythmia in adults, its prevalence is expected to increase by nearly 3-fold during the next 3 decades, with experts now categorizing this epidemiologic trend as an AF epidemic (4).

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The estimated prevalence in the United States is approximately 5.2 million, and is expected to increase to 12.1 million by the year 2030 (4,5). Although numerous factors contribute to this epidemic of AF, the obesity epidemic, which leads to left atrial (LA) remodeling by various mechanisms (4,6,7), is associated with a marked increase in the risk of developing AF. As with other CVDs, however, there is evidence that although obesity increases the risk for the development of AF, overweight and obese patients with AF seem to have a better prognosis, including CVD and all-cause survival, compared to lean AF patients, indicating an apparent obesity paradox (2,7,8).

Although we and others have reviewed the association and impact of obesity on AF (9–11), we believe that this current state-of-the-art review of AF and obesity most comprehensively reviews the adverse effects of obesity on cardiovascular hemodynamics, cardiac structure and function, the electrophysiological effects of obesity, and other mechanisms that may increase the prevalence of AF. We review data on the impact of obesity on prognosis in AF, special management issues in the obese patient with AF, and implications for weight loss and increases in physical activity, exercise training, and improvements in cardiorespiratory fitness (CRF) on prognosis of AF.

OBESITY AND AF: EPIDEMIOLOGICAL CONSIDERATIONS

Early epidemiological studies have uncovered a host of established cardiovascular conditions that are independently associated with the development of AF. More recently, obesity has emerged as an independent risk factor for AF (12–15). For example, long-term prospective data from the Framingham Heart Study with almost 14 years of follow-up has identified obesity as an important modifiable risk factor for AF (12). Importantly, the association between obesity and AF has been shown to be independent of obstructive sleep apnea, a common comorbid condition in obese individuals (13). Furthermore, data from the Women's Health Study have elegantly demonstrated the dynamic nature of the risk for AF with weight changes (14). Specifically, short-term weight gain to BMI >25 kg/m^2 was found to be associated with substantial risk of developing AF, and obese individuals who lost weight to BMI <30 kg/m^2 over 5 years were found to have reduced AF risk similar to those who maintained BMI <30 kg/m^2 over the same period of time (14). Obesity represents the second highest population-attributable risk for AF behind hypertension and will likely escalate the global burden of AF in the coming decades given its burgeoning epidemic worldwide (16). A recent large study reports the association between genetically predicted obesity and AF incidence, making the case that primordial prevention may be needed in the AF epidemic (17).

The ARIC (Atherosclerosis Risk In Communities) study estimates that almost 1 in 5 cases of AF can be attributable to overweight or obesity (16), and another report from the ARIC study showed that trajectories of various CVD risk factors many years before the diagnosis of AF impacted the subsequent development of AF (18). A recent meta-analysis of 51 studies involving more than 600,000 individuals has evaluated the impact of obesity on AF in different clinical scenarios (19). Specifically, every 5-unit increment in BMI was found to confer an additional 19% to 29% risk of incident AF, a 10% risk of post-operative AF, and a 13% risk of post-ablation AF (19). Not surprisingly, longitudinal cohort data from the Women's Health Study and Olmsted County both demonstrated that the obese state contributes to disease progression, whereby increasing BMI was associated with incremental risk of developing a persistent or permanent form of AF (20,21).

ABBREVIATIONS AND ACRONYMS

AF = atrial fibrillation
BMI = body mass index
CHD = coronary heart disease
CRET = cardiac rehabilitation and exercise training
CRF = cardiorespiratory fitness
CVD = cardiovascular disease
EAT = epicardial adipose tissue
HF = heart failure
LA = left atrial
LAE = left atrial enlargement
LV = left ventricle/ventricular
LVH = left ventricular hypertrophy
MET = metabolic equivalent of task
PV = pulmonary vein
RV = right ventricle/ventricular
SVR = systemic vascular resistance

IMPACT OF OBESITY ON CARDIAC PERFORMANCE AND MORPHOLOGY

EFFECTS OF OBESITY ON CARDIAC PERFORMANCE AND MORPHOLOGY: GENERAL CONSIDERATIONS. Obesity is associated with a variety of hemodynamic alterations that predispose to changes in cardiac morphology, which may result in ventricular dysfunction (22–24). The effects of obesity on hemodynamics and cardiac structure and function are summarized in **Table 1 and Figure 1**. These alterations are most pronounced in severely obese patients, but may occur to a lesser extent in those with mild-to-moderate obesity. Excessive adipose accumulation, in association with increased lean body mass, produces an increase in total and central blood volume. In most obese individuals, these alterations promote an increase in cardiac output, a response that is facilitated by a decrease in systemic vascular resistance (SVR). Because there is little change in heart rate, the rise of cardiac output is attributable predominantly to an increase in left ventricular (LV) stroke volume. Augmentation of cardiac output predisposes to LV enlargement and eccentric LV hypertrophy (LVH). Recent studies suggest that central obesity is not always associated with elevated