

CASE REPORTS

Obstructive sleep apnea and heart failure-an often over-looked association

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ABSTRACT

Despite a multitude of therapeutic advances both pharmacologically and in relation to device therapy (cardiac resynchronized therapy), congestive heart failure (CHF) remains a leading cause of morbidity and mortality worldwide. It is therefore important to identify treatable conditions that might alter the prognosis of heart failure. Sleep-disordered breathing (SDB) is one such condition that if treated may alter the progression of HF. Recent literature has shown that patients with both systolic and diastolic heart failure have a high prevalence of SDB.

Key Words: Heart failure, Obstructive sleep apnea, Sleep disordered breathing

1. INTRODUCTION

Despite therapeutic advances in both pharmacology and device therapy (cardiac resynchronized therapy), congestive heart failure (CHF) remains a leading cause of morbidity and mortality worldwide. It is therefore important to identify treatable conditions that might alter the prognosis of heart failure and facilitate the development of additional treatment options.

Sleep-disordered breathing (SDB) is an often, overlooked cause of CHF. Recent literature has shown that patients with both systolic and diastolic heart failure have a high prevalence of sleep apnea.^[1] The literature would suggest that half of all patients with New York Heart Association class I-II heart failure symptoms have significant evidence of SDB.^[2]

In obstructive apnea (subset of SDB), patients' generally have a narrow pharynx related to fat accumulation in the neck that compromises the pharyngeal lumen.^[3] At sleep on-

set, loss of pharyngeal dilator muscle tone causes complete or partial pharyngeal collapse.^[4] During apneic episodes, negative inspiratory intra-thoracic pressures is generated against the occluded pharynx, which results in increased left ventricle (LV) transmural pressure, and hence afterload.^[5] Venous return to the right ventricular (RV) is also increased which results in an elevated RV pre-load thus inducing pulmonary vasoconstriction causing increasing RV afterload.^[6] Subsequent RV distension and leftward septal displacement during diastole impairs LV filling.^[7] The combination of increased LV afterload and diminished preload detrimentally affects LV systolic function. This effect is enhanced in those with HF.^[8,9]

Overtime, such physiology leads to negative cardiac remodeling, hypertrophy and subsequent heart failure. SDB can also cause CHF through other mechanisms: the promotion of atherosclerosis (the most common cause of HF) and ar-

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rhythmogenic effects.^[10]

The American Heart Association (AHA) has emphasized the importance of testing for sleep apnea in patients with HF given the high morbidity and mortality among this cohort. At present, patients are infrequently tested for sleep apnea and even less are treated despite the plethora of information and guidelines available. This lack of testing/treatment has put an “at risk” population even more in danger. Prospective data has suggested that those patient with CHF that were tested and treated for Obstructive sleep apnea (OSA) went on to have a survival benefit and an observed 50% reduction in Medicare payments, suggesting that treatment of sleep apnea was both clinically and economically beneficial.^[11]

2. CASE PRESENTATION

Mr. DS is a 65-year-old male with a known history of Type A aortic dissection in 2009 with surgical repair and residual thoracic aorta dilation, who presented in rapid atrial flutter and right side heart failure. He was appropriately admitted to hospital for diuresis. His echocardiography at the time showed normal left ventricular function, mild reduction in his right ventricular function, moderate tricuspid regurgitation (TR) and mild to moderate pulmonary hypertension. It was initially unclear whether the precipitant was heart failure causing atrial flutter or vice versa. However, once he was rendered euvoletic, a cavotricuspid isthmus ablation for medical refractory atrial flutter was performed in an effort at rhythm control.

Unfortunately, he returned six months later with anasarca. His initial presentation suggested a non-arrhythmic cause as he was in sinus rhythm. Beyond symptoms of congestions, his review of systems was benign

Mr. DS was admitted and received standard heart failure therapy. His admission weight was 111.1 kg. His blood pressure and heart rate were 127/77 and 54 beats per minute. His jugular venous pressure was greater than 10 cm above the sternal angle and he had bibasilar crackles to the bottom half of both lung fields. His admission medications were Amiodorone 100 mg OD, Carvedilol 25 mg BID, Synthroid 25 mcg OD, Warfarin as per INR. A cardiac magnetic resonance imaging was completed and revealed mild septal flattening on inspiration but no concrete evidence to suggest pericardial constriction. A repeat echocardiogram showed moderate right ventricular dysfunction, moderate pulmonary hypertension (RVSP[Right ventricular Systolic Pressure] 45 mmHg) and severe TR without any observed left sided abnormality apart from mild left ventricular hypertrophy. This was a significant change from his previous exam. Unfortunately, despite extensive imaging, the etiology for his repeat

admission was unclear.

3. TREATMENT

Over the course of the next two weeks Mr. DS underwent diuresis to a weight of 96.4 kg with IV furosemide. He was then transitioned to oral furosemide and a repeat echocardiogram was performed. Figures 1 and 2 illustrate that during a repeat echocardiogram, the patient experienced an apneic period as he slept, resulting in Cheyne Stoke breathing and subsequent increased right ventricular pressure and volume. This produced a characteristic D-shaped septum that was present during systole and diastole. Based on the echocardiogram images and the patient’s symptoms of right-sided heart failure, the likely etiology was OSA. This was the cause for the right ventricular failure/TR severity and pulmonary hypertension. Unfortunately it had gone unrecognized and therefore not treated.

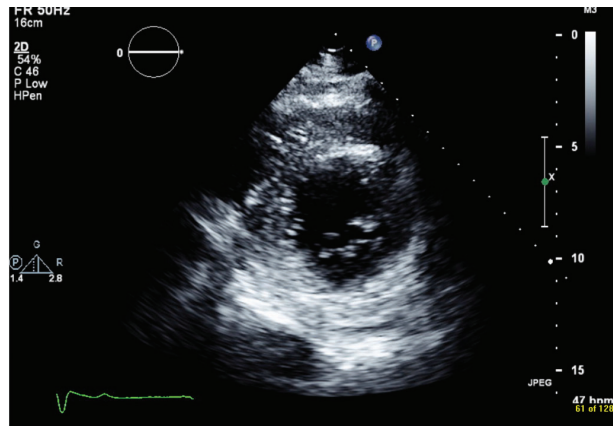


Figure 1. Patient awake with normal left/right ventricular size and motion

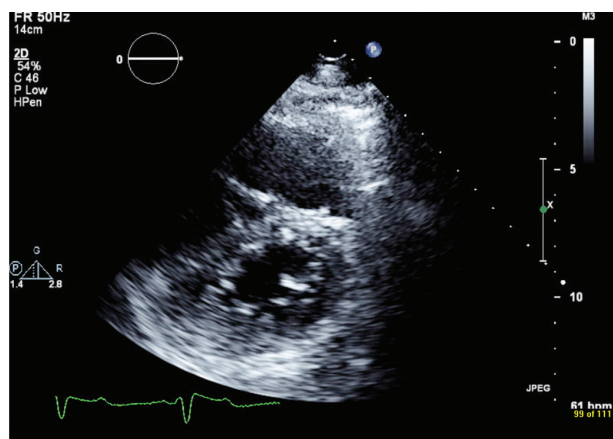


Figure 2. Apnea Event and Subsequent Cheyne-Stoke Breathing. Left Ventricular septum has flattened and the Right ventricular size has enlarged with decreased function

4. MANAGEMENT AND OUTCOME

Due to ongoing symptoms CHF, a right heart catheterization was performed, which confirmed the diagnosis of severe pulmonary hypertension. Further history also revealed daytime somnolence (Epworth score of 8), non-restorative sleep and nighttime leg movements. His wife described observing apneic spells with obstructed breathing likely related to OSA.

An overnight sleep study confirmed the diagnosis and he was fitted and titrated for continuous positive airway pressure (CPAP) ventilation. Once stable, he was discharged, with a plan to be followed in the Heart Function Clinic.

5. DISCUSSION

The prevalence of SDB is increasing among patients with CHF with increasing disease severity.^[19] In the above case, Mr. DS demonstrated SDB during his echocardiogram. SDB is distinguished into OSA syndromes and central sleep apnea syndromes (CSAS), which are both highly prevalent in heart failure.^[20] Cheyne Stokes breathing, which is seen in CSAS is due to damage within the respiratory centers of the brain and can be made worse by physiological abnormalities seen in chronic heart failure. Our patient likely started with obstructive symptoms and later developed a central component of his mixed sleep disorder. Central sleep apnea has an unfavorable prognosis and is independent predictor of mortality in HF.^[21] It is important to be aware of the potential risk of SDB as an etiology for repeated exacerbations or resistant HF.

In regards to the case, the differential diagnosis on admission included: refractory atrial arrhythmia's causing right ventricular failure, severe tricuspid regurgitation and pericardial constriction (pericardium was previous opened for the aortic dissection repair in 2009). OSA was only entertained as a possible etiology at the time of his second echocardiogram in a serendipitous manner. The new diagnosis of OSA also brought into question whether this had also contributed to his previous aortic dissection, by way of increased systemic hypertension. Patients with previous aortic dissections have been found to have a higher prevalence of previously undiagnosed and frequently severe OSAS.^[22] It's thought that OSA leads to increased diastolic blood pressure, which is found to be the main factor in influencing aortic root size.^[23] However, it is not clear whether treatment of OSA decreases your chances of developing an aortic dissection. Thus, the aortic dissection may have been unavoidable in our patients' case.

OSA is a significant comorbidity of HF and is an entity that is often under diagnosed. Whether sleep studies should be routinely performed in patients with CHF is debatable. Benefits of a screening program have to be proven before their implementation. Issues regarding who should be screened, whether there is an available effective treatment and costs of such a program also need to be considered.

Guidelines for the diagnosis of OSA in the general population require a level II or III sleep study. Currently, no concrete guidelines exist for diagnosing OSA in heart failure patients. In general, accesses to resources are limited and wait times are especially long for sleep studies II and III. A focused history is an excellent way to screen at-risk patients. OSA is usually characterized by snoring, apneic spells, and daytime somnolence (Epworth sleepiness scale) and is more prevalent in overweight individuals. Unfortunately, patients with heart failure have less subjective daytime sleepiness,^[12] and thus brings into question the validity of using Epworth sleep scores within the population.

Treatment of OSA with CPAP may lead to dramatic improvement of symptoms, but also result in reverse remodeling of the heart. This may occur irrespective of the presence of CHF.^[13,14] Treating OSA with CPAP has additional positive physiological and clinical benefits by abolishing apnea related hypoxia, lowering nocturnal blood pressure, improving sleep quality^[15] raising left ventricular ejection fraction (LVEF),^[16-18] and reducing catecholamine production.^[18] A recent meta-analysis of 259 patients (10 recently randomized control trials) reported CPAP treatment in OSA patients indicated a 3.59% increase in LVEF, with a 5.18% improvement in LVEF in those with HF symptoms.^[20] Those with no evidence of CHF did not see a statistical improvement in their LVEF during CPAP therapy. The change in structure and function during CPAP therapy over the course of 1- 6 months is summarized in Table 1. Whether this relates to improvement in quality of life (QOL), improvement in NYHA class or survival benefit is yet to be seen. To answer these questions we await the results of two large multicenter, randomized trials, SERVE-HF and ADVENT-HF.

Heart Failure associated with OSA is a very treatable condition once the diagnosis is made, however this rate-limiting step may be challenging. It is essential that HF patients be reviewed for possible signs and symptoms of OSA and that appropriate investigations/treatment be offered. SDB is often unrecognized and its importance is neglected in clinical practice.

Table 1. Benefits of Treating OSA on Cardiac Function and Structure

	Ventricular Function	End Systolic Volume	End Diastolic Volume	Ventricular Wall Thickness	Myocardial Perfusion	Atrial Volume Index	Pulmonary Hypertension
Left Ventricle	↑**	↓	↓	↓*	≠	↓*	N/A
Right Ventricle	↑*	↓	↓*	↓	≠	↓*	↓*

*Statistically significant ($p < .05$);

**Effect seen in those with CHF symptoms.

6. SUMMARY

This case illustrates three very important points for consideration in the management of patients with heart failure:

- In patients with refractory or unexplained HF consideration for OSA as a cause should be entertained. Initial history and clinical exam should be followed with echocardiographic examination with particular attention paid to the degree of pulmonary hypertension (RVSP), RV dysfunction, septal morphology, and right atrial enlargement.

- Once OSA has been uncovered and treatment has been started, systematic evaluation of ventricular function (right and left) as well as degree of pulmonary hypertension should be considered within 3-6 months. These findings should also be correlated to clinical symptoms.
- If symptoms continue despite initiation of appropriate therapy, consider another diagnosis. However, if clinical symptoms of OSA persist, consider a lack of compliance or failure of treatment with CPAP.

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