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Case Report

# Successful termination of recurrent ventricular arrhythmias by adaptive servo-ventilation in a patient with heart failure

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**KEYWORDS**
Adaptive servo-ventilation;
Sleep disorder breathing;
Heart failure;
Ventricular tachycardia;
Sympathetic nerve activity

**Summary** A 60-year-old woman who underwent operation due to severe aortic stenosis with left ventricular dysfunction had frequent nonsustained ventricular tachycardia (NSVT) at night. She had an increased apnea—hypopnea index and a reduction in minimum $O_2$ saturation during sleep, which was closely associated with the frequency of NSVT. Adaptive servo-ventilation (ASV) therapy improved sleep disorder breathing (SDB) and also reduced ventricular arrhythmias. These effects were associated with the attenuation of the sympathetic nerve activities by the analysis of heart rate variability. ASV is expected to be effective in the treatment of ventricular tachyarrhythmias in patients with heart failure and SDB.


## Introduction

Patients with heart failure (HF) often have sleep disorder breathing (SDB), especially Cheyne—Stokes respiration. The prevalence of this association has been reported to be between 40% and 50% in HF [1,2]. SDB has been shown to be associated with an increased risk for the fatal arrhythmias and sudden cardiac death [3]. Approximately 20—35% of patients with SDB have premature ventricular contraction and 3.0—5.3% of those have nonsustained ventricular tachycardia (NSVT) [4,5], suggesting that SDB may trigger lethal ventricular arrhythmias. In patients with SDB, recurrent nocturnal apnea and hypopnea during sleep activate sympathetic nerve activity, which may not only worsen HF but also trigger lethal ventricular arrhythmias. Adaptive servo-ventilation (ASV) is a novel therapy for SDB in patients with HF [6]. It can not only normalize the pattern of respiration and quality of sleep, but also stabilize sympathetic nerve activity [7]. Therefore, it is also expected to reduce lethal arrhythmias in patients with HF and SDB. This is a

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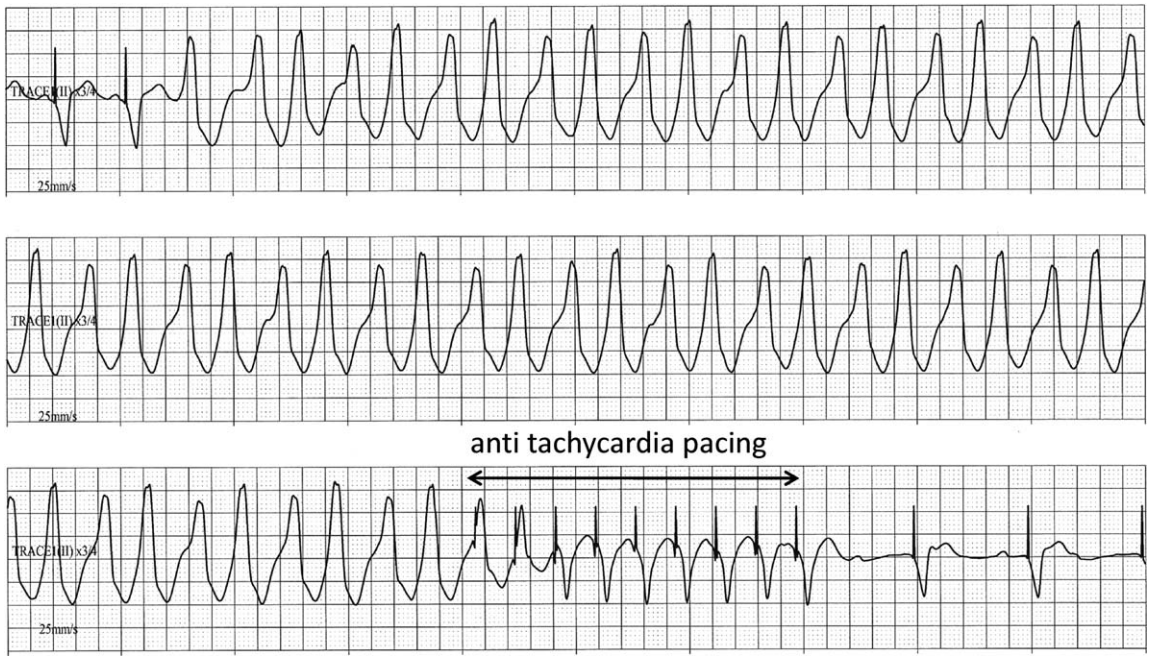


**Figure 1** The electrocardiogram monitor shows sustained ventricular tachycardia terminated by the anti-tachycardia pacing of the implantable cardioverter-defibrillator.

first report showing successful termination of ventricular arrhythmias including NSVT by ASV in a patient with chronic HF.

## Case report

A 60-year-old woman who had undergone aortic valve replacement for severe aortic stenosis with left ventricular (LV) dysfunction and prior history of pulmonary edema was admitted to our cardiology ward for the treatment of HF. On admission, her heart rate was 60 beats per minute, and blood pressure was 94/68 mmHg. She did not have jugular venous distension, lower leg edema, or rales. A 12-lead electrocardiogram (ECG) revealed complete atrioventricular block with junctional escape rhythm and sporadic episodes of NSVT. Chest X-ray showed slight enlargement of the heart, cardiothoracic ratio 56%, but no obvious pulmonary congestion. Serum creatinine was 1.0 mg/dl, and plasma brain natriuretic peptide (BNP) value was elevated to 659 pg/ml. Echocardiography showed diffuse LV hypokinesis with ejection fraction (EF) of 27%. No abnormalities in prosthetic aortic valve were detected. The septal to posterior wall motion delay was 264 ms, and tissue Doppler echocardiography demonstrated that the standard deviation of time to peak systolic velocity of 12 segments of the LV wall at the basal and medial levels was 41.3 ms, indicating the presence of LV dyssynchrony. She had standard medical treatment including carvedilol 10 mg, enalapril 2.5 mg, furosemide 60 mg, spironolactone 50 mg, and amiodarone 400 mg. Cardiac resynchronization therapy with defibrillator was performed for the treatment of HF with low EF and complete atioventricular block. Even after the stabilization of HF, frequent NSVT persisted and electrical storm terminated by implantable cardioverter-defibrillator occurred mainly during sleep (Figs. 1—3). A portable sleep monitoring device type 3 (Morpheus; Teijin Pharma, Tokyo, Japan) [8] revealed that apnea—hypopnea index (AHI) was 15.2/h and minimum oxygen saturation ($SpO_2$) was decreased to 84% at night, confirming the presence of SDB, mainly obstructive sleep apnea (Fig. 3). Moreover, 24-h ECG monitoring showed that ventricular arrhythmias such as premature ventricular contraction (PVC) and NSVT were noted during sleep (Fig. 2), which coincided with the decrease in $SpO_2$.ASV (Auto Set CS; Teijin Pharma, Tokyo) was started without oxygenation and full face masks (Teijin Pharma) in the default settings; expiratory positive airway pressure of 5 cm $H_2O$, inspiratory

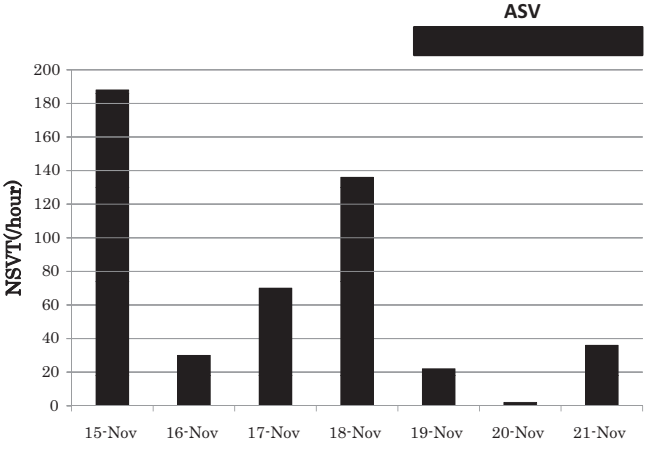


**Figure 2** The number of nonsustained ventricular tachycardia (NSVT) counted by bedside monitoring electrocardiogram. It remarkably decreased after adaptive servo-ventilation (ASV) therapy was initiated. The medications were not changed during this period.