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Case Report

Heart rate variability in a patient after percutaneous renal denervation: a case report

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ABSTRACT

The overactivity of sympathetic component of autonomic nervous system is implicated in the genesis and progression of hypertension. We report the heart rate variability (HRV) of a patient after renal denervation for treatment of medically resistant hypertension. Catheter based renal denervation done for treatment of resistant hypertension reduces blood pressure by reducing the central sympathetic drive. In the present study we found a significant decrease in low frequency component of HRV in one month follow-up period after the procedure. We propose a simple, non-invasive 5-minute HRV could be a predictor of effective renal sympathetic denervation.

Keywords: Heart rate variability, Renal denervation, Resistant hypertension

INTRODUCTION

The autonomic nervous system and especially its sympathetic component play an important role in regulation of blood pressure. Renal sympathetic tone in particular plays an important role in goal blood pressure regulation through renin secretion by the juxta-glomerular apparatus and vasoconstriction of renal arterioles. Catheter based renal denervation by radiofrequency energy offers a newer, safer and effective approach for treatment of hypertension resistant to medical treatment. Renal denervation reduces blood pressure by decreasing central sympathetic tone. Heart rate variability (HRV) may be used to assess autonomic balance to the heart in a number of disease conditions including cardiovascular diseases. In the present study we evaluated HRV pre-operatively and after 1 month follow-up period to assess if it is a predictor of effective renal denervation.

CASE REPORT

A 65 year old female, diabetic (blood sugar fasting 126±10mg/dl / post-prandial 200±10mg/dl) patient presented with an office blood pressure (BP) systolic ≥180 mmHg/ diastolic ≥110 mmHg inspite of intake of 3 anti-hypertensive drugs including one diuretic. Secondary causes of hypertension like renal disease, renal artery stenosis, atrial fibrillation, endocrine disorders were ruled out. Informed consent of the patient was taken and 3 consecutive 5-minute, lead- II ECG (Tele-ECG unit) readings were recorded at a sampling rate of 500 samples/second. The readings were taken pre-operatively and after 1 month follow-up period. On both days, all recordings were made at the same time of day, a minimum of 2 hrs after intake of food and 4 hrs after consumption of caffeine containing beverages. The data was subjected to frequency-domain HRV analysis using heart rate variability software (BAS-software from Bhabha Atomic Research Centre, Mumbai).

Figure 1 and Figure 2 illustrate frequency analysis in the patient from a 5-minute HRV recording before and after undergoing percutaneous renal denervation. The low frequency component of HRV spectrum (0.04-0.15 Hz) which is often used as an accurate reflection of sympathetic activity was decreased from 4.964 pre-operatively to 1.853 post-operatively. Office blood pressure measurement immediately in the post-operative period showed reduction in BP by 20/6±6/4 mmHg. At 1 month follow-up BPs were reduced by 30/10±10/8 mmHg.

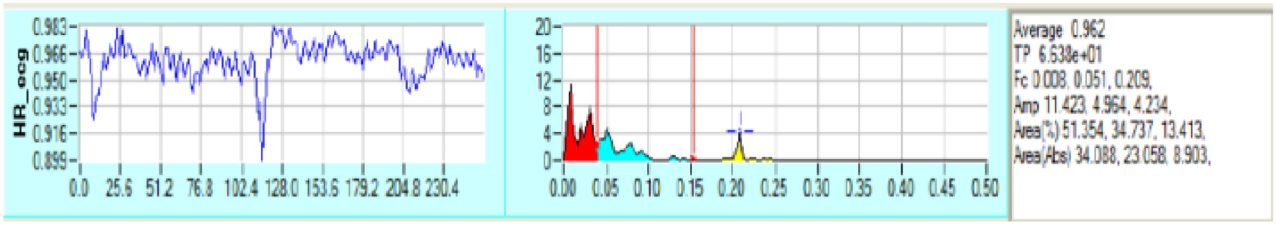

Figure 1: Heart rate variability pre-operatively.

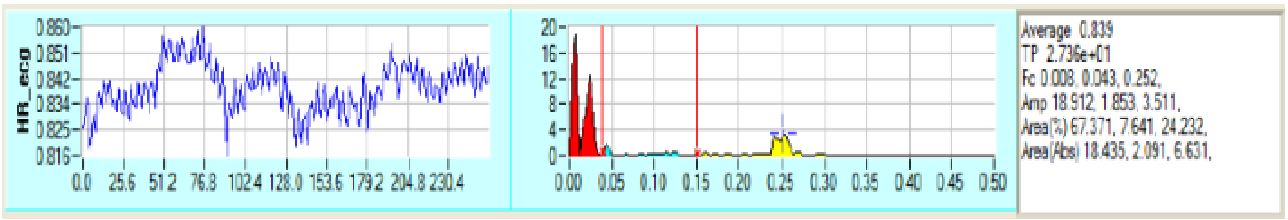

Figure 2: Heart rate variability 1 month follow-up post-operatively.

DISCUSSION

Essential hypertension accounts for 95% of all cases of hypertension. Resistant hypertension is defined as high blood pressure that remains uncontrolled despite treatment with 3 anti-hypertensive drugs at least one of which is a diuretic, at maximally tolerated doses. Excessive sympathetic drive to cardiovascular organs and the kidney is known to play an important pathophysiological role in essential hypertension. This is evident from the anti-hypertensive effect of various drugs that block the sympathetic activity either centrally or peripherally.[1]

Sympatho-renal interactions may lead to inappropriate activation of intra-renal renin-angiotensin system. Angiotensin II exerts an important role in the pathogenesis of hypertension via activation of AT1 receptors, sodium and water retention and vasoconstriction of renal arterioles.[2] The kidney also transmits impulses via afferent sympathetic fibres to neurons of posterior grey column of spinal cord and further transmitted to autonomic centres in the central nervous system and to contralateral kidney as well.[3] It can thus provide input and modulate central sympathetic drive.

Catheter based renal denervation clinical trials (Symplicity HTN-1 and HTN-2) for patients with uncontrolled hypertension have shown that it is a safe procedure and can produce sustained decrease in blood pressure.[4,5] The reduction in renal sympathetic signalling reduces overall sympathetic drive was proved by reduction in renal nor-epinephrine spill-over as well as decrease in total body nor-epinephrine spill-over in patients after renal denervation.[6] This was further confirmed by decrease in muscle sympathetic activity of these patients to normal as recorded by microneurography at 30 days and 12 months after follow-up.[7]

Heart rate variability is the beat-to-beat oscillation of RR intervals around its mean value. According to European task Force recommendations, 3 main spectral components are distinguished in a short term recording spectrum. These are very low frequency (vLF), low frequency (LF) and high frequency (HF) components. The low frequency (LF) component when expressed in normalized units, is a quantitative marker for sympathetic modulations. The high frequency component co-relates closely with vagal parasympathetic tone.[8] A decrease in overall sympathetic tone would be reflected in reduction in cardiac sympathetic drive.

In 2012, Himmel F et al did spectral analysis of 24 hour Holter electrocardiographic recordings in 14 patients 3 months after renal denervation. They found a significant decrease in cardiac sympathetic tone (low frequency spectral component) before and after treatment. They concluded that renal denervation has a beneficial effect on cardiac physiology in hypertensive patients.[9] In accordance, in our study we also found a significant decrease in low frequency component of HRV indicating renal denervation has caused reduction in central sympathetic tone. In addition to this being cardioprotective we propose that a simple, 5-minute record of HRV frequency analysis could be used to record effective renal denervation in patients. This however needs to be further analyzed over a longer follow-up period and in more number of patients undergoing renal denervation.

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