

Increased High Frequency Compared to Low Frequency Power in Heart Rate Variability in Parkinsonism

Rajani Bala Jasrotia¹, Pramita Dubey^{1,*}, Arvind Kanchan², Nitin Ashok John¹

ABSTRACT

Heart rate variability (HRV) decreases in Parkinson's disease which could be a consequence of reduced motor activity besides being a marker of cardiovascular dysautonomia. The diurnal low frequency power and high frequency power decrease in advanced Parkinsonism. In this case, there is decreased low frequency (LF) but high frequency (HF) is found to be very high compared to LF, which needs explanation. Multiple lobed pattern on Poincare plot in this case increases SD1, which has an analogy to HF, therefore HF is increased. If we remove premature beats from the recording while analysing, and then frame Poincare plot, it would be a normal torpedo pattern and HF value will be decreased in this case like LF, as is normally found in Parkinsonism, which would truly reflect the HRV values due to autonomic effects. HRV report should be interpreted for autonomic dysfunction when Poincare plot is torpedo pattern as other patterns may signify some intrinsic disease of heart.

Key words: Parkinsonism, Heart rate variability, High frequency, Multiple lobed Poincaré plot, LF-HF ratio.

INTRODUCTION

Neurological disorders are the primary cause of disability, and there is increasing burden of neurodegenerative disorders, including Parkinson's disease (PD).^[1] Autonomic nervous system (ANS) dysfunction is common in PD, affecting 70% to 80% of patients, and causes significant morbidity and discomfort.^[2] Heart rate variability (HRV) has been studied in Parkinsonism and it was associated with disease severity.^[3] HRV decreases in PD which could only be a consequence of reduced motor activity besides being a marker of cardiovascular dysautonomia. The diurnal low frequency power and the ratio of low frequency (LF) and high frequency (HF) power decreased in advanced Parkinsonism with motor complications. The nocturnal vagal indicators such as HF power and pNNS50 (the mean number of times an hour in which the change in successive normal sinus intervals exceeds 50 ms) were found to be decreased in later stages. Despite higher motor activity due to dyskinesia, LF was low which suggested a defective cardiovascular up-regulation.^[4] In this case report, there was decreased LF but HF was found to be very high compared to LF, which needs explanation.

CASE REPORT

This is a case of 55 year old male presented with pain in left arm while sleeping, for last 8-9 years, which was relieved on hot fomentation and on use of hard collar. Patient also complained of paresthesia in left

index finger for last 5 to 6 years which be due to mild cord compression at C6-C7. There was also a history of fall, 4 years back. For last 2 years, patient complained of weakness and unable to walk, speak and write properly and had a history of postural hypotension. There were hand tremors and short stepping gait. The subject had decreased sleep and night terrors. Recent memory was affected. Patient had a history of regular alcohol intake 2 years ago and takes tobacco presently. There was no history of diabetes and hypertension.

Upon examination, cerebellar speech was found.

Upon investigations, the findings were: MRI head and cervico-dorsal spine showed mild cerebellar hypertrophy, foci of microangiopathic changes in bilateral semiovale region and disc degenerative changes noted in cervical spine predominantly at C5-C6 and C6-C7 level with mild cord compression. Complete blood count, random blood sugar, renal function test, serum sodium, potassium, calcium, thyroid stimulating hormone, anti-thyropoxidase, viral markers by ELISA, serum Vitamin B₁₂ level, serum prostatic specific antigen, ultrasonography whole abdomen, X ray chest postero-anterior view, urine routine and microscopy and culture were normal. Patient was on Tab Propranolol 20 mg twice a day, Tab Vitamin E Once a day, Tab Vitamin C 500 mg 2 Tab twice a day, Tab multivitamin containing

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alfa lipoic acid once a day. Autonomic function test (AFT) report is Table 1. Poincare plot is shown in Figure 1(a).

DISCUSSION

The prevalence of Parkinsonism was increasing globally.^[1] Its autonomic disability increased the morbidity which needs emphasis. Generally, decreased LF and HF was observed in Parkinsonism but in this case, HF was very high compared to LF, leading to very low LF-HF ratio. Poincare plot in this case is not a normal torpedo pattern but a multiple lobed pattern.^[6] This multiple lobed pattern increases SD1, which has an analogy to HR_{V} ^[7] therefore HF was increased. These multiple lobes were due to premature atrial contractions^[6] in this case, which was also visible in electrocardiography while recording HRV. These premature atrial contractions were intrinsic abnormality of heart which alters the HRV.^[8] If the premature beats [Figure 1(b,c)] were removed from the recording while analysing, and then frame the Poincaré plot, it would be a normal torpedo pattern and HF value will be decreased in this case like LF, as is normally found in Parkinsonism, which would truly reflected the HRV values due to autonomic effects. Then, other autonomic tests values (abnormal parasympathetic response) would be comparable with HRV values. Figures 1 (d, e) and Table 1 are showing how to remove premature contractions and the Poincaré plot and HRV values obtained after removing premature atrial contractions.

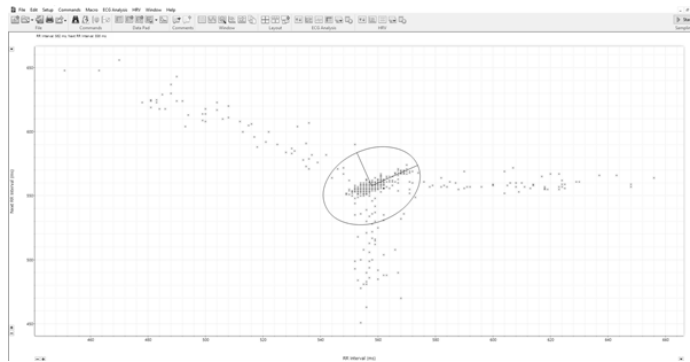


Figure 1(a): Poincaré plot: multiple lobed poincaré plot. Multiple lobed poincaré plot was due to intrinsic defect of heart (i.e. premature atrial contractions). It does not purely reflect autonomic activity of cardiovascular system.

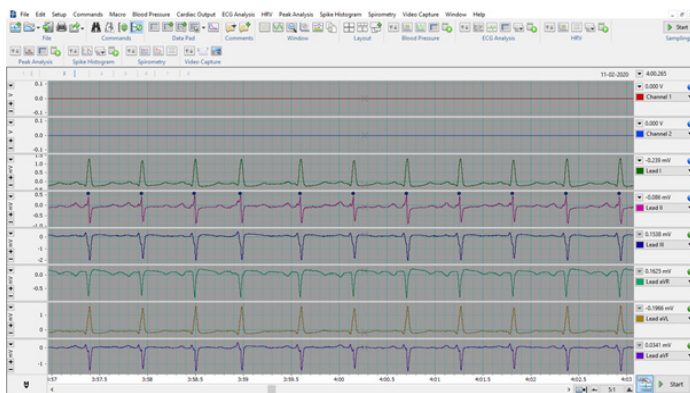


Figure 1(b): Premature atrial contraction at 3:59 picked (marked with blue dot like other beats) during HRV analysis resulted in multiple lobed Poincaré plot

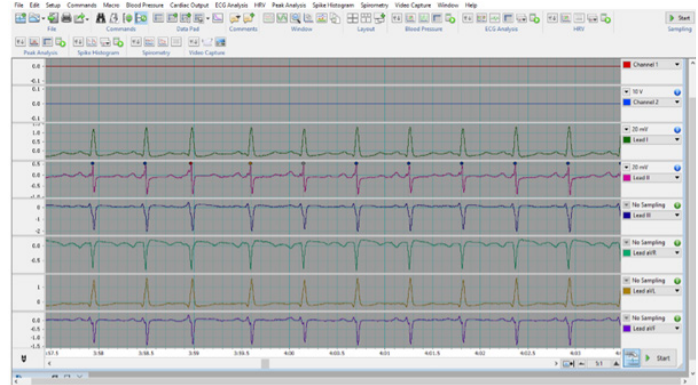


Figure 1(c): Premature atrial contraction at 3:59 not picked (marked with red dot together with 2 other consecutive beats marked yellow and grey) during HRV analysis resulting in torpedo pattern poincaré plot.

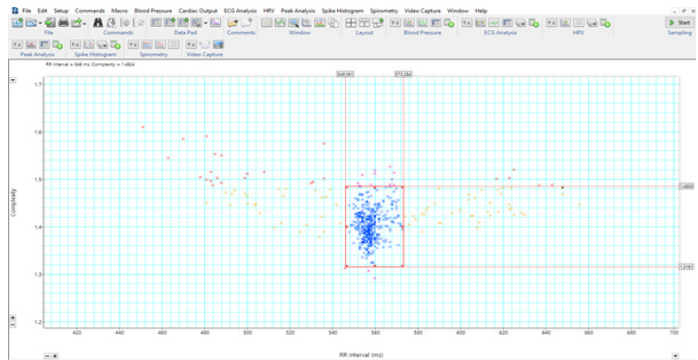


Figure 1(d): Figure showing how to remove premature atrial contractions. Selecting beats apart from premature atrial contraction beats, matched on HRV Electrocardiogram record.

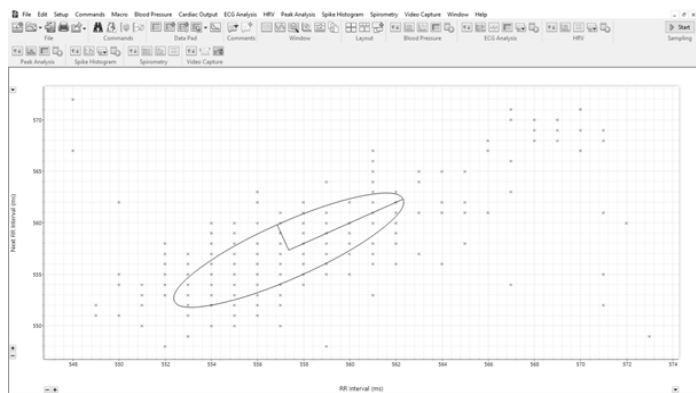


Figure 1(e): Torpedo pattern poincaré plot obtained after removing premature atrial contraction beats. It now reflects ANS activity of cardiovascular system

Table 1: AFT Report including HRV report before and after removing premature contractions.

| AFT parameter | Value |
|---|--|
| 30:15 ratio | 0.992 (abnormal)[5] |
| Deep breathing difference (DBD) | 10 (borderline)[5] |
| Valsalva ratio | 0.9538 (abnormal)[5] |
| Diastolic blood pressure (DBP) response to sustained handgrip | 5 mm mercury (abnormal)[5] |
| Total power (before/after*) | 153 millisecond ² (ms ²)/ 12.75 ms ² |
| VLF (before/after*) | 5.355 ms ² /6.491 ms ² |
| LF (before/after*) | 3.433 ms ² /2.648 ms ² |
| HF (before/after*) | 87.68 ms ² /3.397 ms ² |
| LF/HF Ratio (before/after*) | 0.03916/0.7793 |
| Standard deviation1 (SD1) (before/after*) | 26.9 millisecond (ms)/2.706 ms |
| Standard deviation2 (SD2) (before/after*) | 16.64 ms/5.441 ms |

*Before/after: Before and after removing premature contractions

CONCLUSION

This study concluded that HRV report should be interpreted for autonomic dysfunction when Poincaré plot is torpedo pattern as other patterns may signify some intrinsic disease of heart and not autonomic dysfunction. Premature atrial contraction beats can be removed while analysing HRV by changing settings to obtain a torpedo pattern. Then HRV will be a true reflection of autonomic dysfunction.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

ANS: Autonomic Nervous System; **HRV:** Heart Rate Variability; **LF:** Low Frequency; **HF:** High Frequency.

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