# Effect of Percutaneous Coronary Intervention on Heart Rate Variability in Coronary Artery Disease Patients

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## Abstract

Patients with coronary artery disease (CAD) have a state of autonomic imbalance with a sympathetic predominance. Autonomic dysfunction has been linked to an increased risk of cardiovascular morbidity and mortality. Heart rate variability (HRV) analysis is one of the most encouraging non-invasive diagnostic models and is increasingly used for the assessment of autonomic dysfunction. Percutaneous coronary intervention (PCI) is considered the gold standard in CAD treatment. Revascularisation through PCI eliminates the state of sympathetic hyperactivity, restores the normal cardiac autonomic modulation that can be assessed by HRV measurement.

## Keywords

Coronary artery disease, percutaneous coronary intervention, heart rate variability

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Coronary artery disease (CAD) is the most common cause of morbidity and premature mortality globally,[1] and cardiac autonomic dysfunction is one of the risk factors for CAD.[2] Heart rate variability (HRV) is the physiological phenomenon of variation in the time interval between heartbeats and is one of the most promising non-invasive diagnostic methods for assessing autonomic dysfunction.

HRV measurement can efficiently reflect the activity of both sympathetic and vagal components of the autonomic nervous system on the sinus node of the heart.[3] It is well established that reduced HRV is an independent predictor of sudden cardiac death in congestive heart failure, poorer outcomes for survivors of acute MI (AMI), and increased cardiovascular risk in people with diabetes.[4–7]

## Effect of Coronary Revascularisation in the Restoration of Normal Autonomic Balance

Patients with CAD and exercise-induced angina have a state of autonomic dysfunction in the form of sympathetic overstimulation, which is considered to be triggered by myocardial ischaemia.[8] Many studies have linked CAD to reduced HRV even in the absence of heart failure or previous MI.[2,9] Theoretically, coronary revascularisation in CAD patients by percutaneous coronary intervention (PCI) could restore the normal autonomic balance, which can be proved and quantified by HRV measurement.

This theory has been proved in several trials. Bonnemeier et al. assessed the effect of successful reperfusion by primary PCI on HRV after AMI.[10] The principal conclusion of the study was that early reperfusion in AMI resulted in a significant recovery of HRV parameters, which indicates vagal activation and sympathetic withdrawal. HRV was significantly lower in patients undergoing late perfusion compared with those with early reperfusion. Early reperfusion has a beneficial effect by normalisation of HRV, reflecting attenuation of cardiac autonomic impairment that yields a better outcome after AMI.

Sedziwy et al. studied HRV time domains in patients before PCI and during a 1-year follow-up after PCI using serial 24-hour Holter monitoring.[11] They concluded that successful revascularisation using PCI led to a significant improvement in HRV autonomic balance.

Aydinlar et al. investigated the effect of PCI on QT dispersion and HRV in patients with single-vessel CAD who underwent elective PCI.[12] They concluded that HRV parameters significantly improved after PCI. Abrootan et al. studied changes in HRV parameters after elective PCI in patients with stable angina pectoris showing that short-term HRV parameters improved 24 hours after PCI.[8] Thes two studies show that PCI is associated with an improved autonomic modulation and overall survival in CAD patients.

## Current Limitations of Using Heart Rate Variability in Clinical Practice

Despite several published experimental and clinical trials of HRV measurement, the use of HRV is limited to research and not routinely used in daily clinical practice.[9] This can be explained by several factors.

The clinical application of HRV assessment is limited by the lack of standard methods and the variability of parameters such as gender, age, drug interferences and concomitant diseases. There is still no consensus about the most accurate HRV parameter for clinical usage. The sensitivity, specificity and positive predictive accuracy of HRV in risk stratification are still limited. Notably, its positive predictive accuracy is modest, ranging from 14 % to 40 %. However, it has a higher negative

predictive value, ranging from 77 % to 98 %.[9] Conflicting data suggest that it may be insufficient by itself for adequate risk stratification in high-risk patients. The combination of HRV with other risk stratification methods, including left ventricular ejection fraction, non-sustained ventricular tachycardia, and baroreceptor sensitivity may increase the overall predictive accuracy.[13,14]

## Conclusion

HRV is one of the most promising methods for detection and quantification of autonomic dysfunction. Further research is required for further validation of its effectiveness in clinical usage and its usefulness in risk stratification and as an independent prognostic factor for CAD. ■


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