Five-minute heart rate variability can predict obstructive coronary disease
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Background
- Despite the use of screening tests and risk-factor profiling, significant coronary artery disease (CAD) is absent in up to half of patients referred for diagnostic coronary angiography.
- Heart rate variability (HRV) is a surrogate measure of the autonomic nervous system, allowing a non-invasive method to assess the balance of sympathetic (low and high frequency HRV) and parasympathetic tone (high frequency).
- HRV can successfully identify those at risk of death from CAD and differentiate patients who will face a complicated course following myocardial infarction (MI).
- Reduced variability is also a predictor for all-cause mortality in those free of apparent CAD as well as in congestive heart failure.
- However HRV has not entered routine clinical practice due to the impracticalities of traditional 24-hour recordings. We hypothesized that 5-minute HRV would improve the prediction of angiographic CAD when added to conventional risk factors and electrocardiograms (ECG).

Methods
- Consecutive patients referred for elective coronary angiography not precipitated by an acute coronary event were assessed prospectively at these centres. 470 who were enrolled in a double-blinded fashion with risk assessments performed prior to angiography and angiography operators blinded to results.
- HRV was obtained with the participant supine, asked to breathe normally and left undisturbed during the capture time (mean 5.78 ± 0.52 minutes). To simulate actual clinical use, no attempt was made to control patient or environmental factors or to rest the participant prior to HRV capture. SphingCor software (Acclor Medical, Sydney) was used to quantify normal-to-normal RR intervals and deconstruct HRV into component frequencies.
- Logistic regression was used to compare patients with and without obstructive CAD (50% stenosis in a native vessel). Coronary angiography was performed and classified by experienced operators using standardized procedures according to international guidelines. An angiographic core laboratory reviewed any angiograms where there was uncertainty about classification (8.5%), as well as a random sample of 10% of angiograms at each centre for quality assurance.

Results
- HRV capture was unsuccessful in 59 patients (11%). Rhythm abnormalities on HRV capture was unsuccessful in 59 patients (11%). Rhythm abnormalities on HRV capture was unsuccessful in 59 patients (11%). Rhythm abnormalities on HRV capture was unsuccessful in 59 patients (11%). Rhythm abnormalities on HRV capture was unsuccessful in 59 patients (11%). Rhythm abnormalities on HRV capture was unsuccessful in 59 patients (11%). Rhythm abnormalities on HRV capture was unsuccessful in 59 patients (11%). Rhythm abnormalities on HRV capture was unsuccessful in 59 patients (11%). Rhythm abnormalities on HRV failure on 25-30% lower in patients with angiography not precipitated by an acute coronary event.

HRV as a Predictor of Obstructive Coronary Disease
- Low frequency HRV was a strong independent predictor of the presence of obstructive CAD in multivariable analysis. In contrast ECG variables were not independent of other risk factors.
- Reduced HRV as a predictor of CAD was equally effective across patient sub-groups. Interaction p-values were non-significant, indicating the benefit of identifying LF power <250ms² regardless of baseline risk factors.

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Risk Factor Interactions
- There were no major interactions of 5-minute low frequency power with conventional risk factors and only a weak correlation with heart rate. HRV was reduced in diabetics compared to non-diabetics but not affected by gender, smoking or time of assessment.

Association with Angiographic Coronary Disease
- A number of ECG and HRV variables were crudely associated with CAD. Low frequency HRV was the most discriminating, with the optimal cut-off being 250ms².

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CONCLUSIONS
- Individual risk assessment to identify coronary artery disease in men and women can be inaccurate, as evidenced by the high proportion of normal angiograms and false-positive stress tests.
- Heart rate variability is a suitable clinical tool in patients without rhythm abnormalities, regardless of other cardiac co-morbidities.
- Low frequency HRV power is an independent predictor of coronary disease, applicable across patients sub-groups, adds to conventional risk factors and is superior to standard 12-lead ECG recordings.