

Electrocardiographic variables are strongly associated with ambulatory hypertension in young and healthy adults

Stefanie Aeschbacher¹, Thomas Hochgruber¹, Tobias Schoen¹, Roger Abächerli², Martin Risch³, Lorenz Risch³, David Conen¹

¹ University Hospital Base, Switzerland ² Schiller AG, Baar, Switzerland ³ Labormedizinisches Zentrum Dr. Risch, Schaan Principality of Liechtenstein

Background

- Ambulatory 24-hour blood pressure (BP) measurement is relatively expensive, not routinely available and uncomfortable for an individual patient. Therefore parameters obtained by electrocardiography (ECG) might be useful to improve the selection of individuals who may benefit from an ambulatory BP measurement.
- The aim of this study was therefore to evaluate the relationships between ECG variables and ambulatory hypertension in young and healthy adults.

Methods

- Population based cross-sectional study of 750 healthy individuals aged 25-41 years, all of whom were part of the population based 'Genetic and Phenotypic Determinants of Blood Pressure and Other Cardiovascular Risk Factors' (GAPP) Study in the Principality of Liechtenstein.
- Exclusion criteria: Cardiovascular disease, body mass index (BMI) > 35kg/m² and antihypertensive treatment.
- 24-hour BP measurement and standard 12-lead ECG were performed using validated devices (BR102plus and AT104, Schiller AG, Switzerland).
- Hypertension was defined as a systolic daytime BP ≥140mmHg and/or diastolic daytime BP ≥ 90mmHg.
- Models were adjusted for easily available variables such as age, sex and BMI.
- First the relationship between hypertension and single ECG indices (continuous and across quartiles) was assessed using logistic regression analyses.
- Further, a combined model with the significant ECG indices and adjusted for sex, age and BMI was done to assess the c-statistic.

Table 1 Baseline characteristics

Total n = 750	Normotensive n = 614 (81.9%)	Hypertensive n = 136 (18.1%)	p-value
Male sex (%)	232 (37.8)	111 (81.6)	<0.0001
Age (y)	38 (33; 41)	40 (33; 41)	0.0002
BMI (kg/m ²)	24.2 ± 3.7	26.3 ± 3.5	<0.0001
Current smoking (%)	128 (20.9)	35 (25.7)	0.21
BP sys 24h (mmHg)	119.1 ± 8.5	137.7 ± 9.4	<0.0001
BP dia 24h (mmHg)	76.1 ± 5.8	90.2 ± 6.2	<0.0001
Heart rate (bpm)	71.7 ± 11.1	70.4 ± 11.0	0.23

Data are numbers (percentage), means ± SD or medians (IQ range).
Sys=systolic; dia=diastolic.

Table 2 Independent ECG indices of ambulatory daytime hypertension

	OR (95% CI)	p-value
P Axis Quartile 1 (°)	1.00 (Reference)	0.03
P Axis Quartile 2 (°)	1.19 (0.69; 2.05)	
P Axis Quartile 3 (°)	0.90 (0.53; 1.55)	
P Axis Quartile 4 (°)	0.47 (0.24; 0.91)	
RR interval Quartile 1 (ms)	1.00 (Reference)	0.058
RR interval Quartile 2 (ms)	1.00 (0.58; 1.70)	
RR interval Quartile 3 (ms)	0.88 (0.51; 1.54)	
RR interval Quartile 4 (ms)	0.56 (0.31; 1.01)	
R Amplitude lead I per 1mV increase	2.62 (1.18; 5.82)	0.02
T Amplitude lead V2 per 1mV increase	5.00 (2.17; 11.5)	0.0002
T Amplitude lead V5 per 1 mV increase	0.20 (0.06; 0.65)	0.008

Model adjusted for sex, age, BMI. OR = Odds ratio; CI = Confidence Interval

Results

- Of 750 individuals, 136 (18.1%) had hypertension.
- Hypertensive participants were more often male, significantly older and had a higher BMI (**table 1**).
- ECG indices (continuous and across quartiles) that were significant in multivariable logistic regression analyses are shown in **table 2**.
- In a combined multivariable logistic regression analysis including all significant ECG variables shown in table 2 and age, sex and BMI as covariates, the c-statistic was 0.80.
- The T wave amplitude in lead V2 was a particularly strong predictor for ambulatory hypertension in the adjusted combined model (including all other ECG indices), with an odds ratio (95% confidence interval) of 5.23 (2.16; 12.68), p=0.0002.

Conclusion

- Easily available ECG indices were significantly associated with daytime hypertension on ambulatory BP measurement, independent of clinical variables.
- The high c-statistic of the combined model suggests that these indices may be useful to select individuals who may benefit from 24-hour BP measurement.