Role of P Wave Indices in Normal Sinus Rhythm and Tachycardia

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Keywords

- Atrial Fibrillation
- Electrocardiogram
- P wave axis
- P wave dispersion
- P wave indices
- Sinus rhythm
- Sinus tachycardia

Objectives

- To illustrate the extended implications drawn from P Wave Indices (PWI) for determination of tachycardia.

- To study the PWI such as P wave axis, amplitude, duration, dispersion, PP Interval (PPI) and PR Interval in Sinus Rhythm (SR) and Sinus Tachycardia (ST).

Methods

Study population

- ECGs were recorded from 50 SR (mean ± SD; 35 ± 18.42) and 25 ST (19 ± 3.93) volunteers.

Data Acquisition

- EDAN PC-1010 machine was used to record ECG for limb leads at the standard paper speed.

Statistical analysis

- All the values are given in mean ± SD. Kolmogorov Smirnov test, Pearson's correlation, 2 tailed Student's T-test were performed. $P < 0.05$ (level of significance).

Results

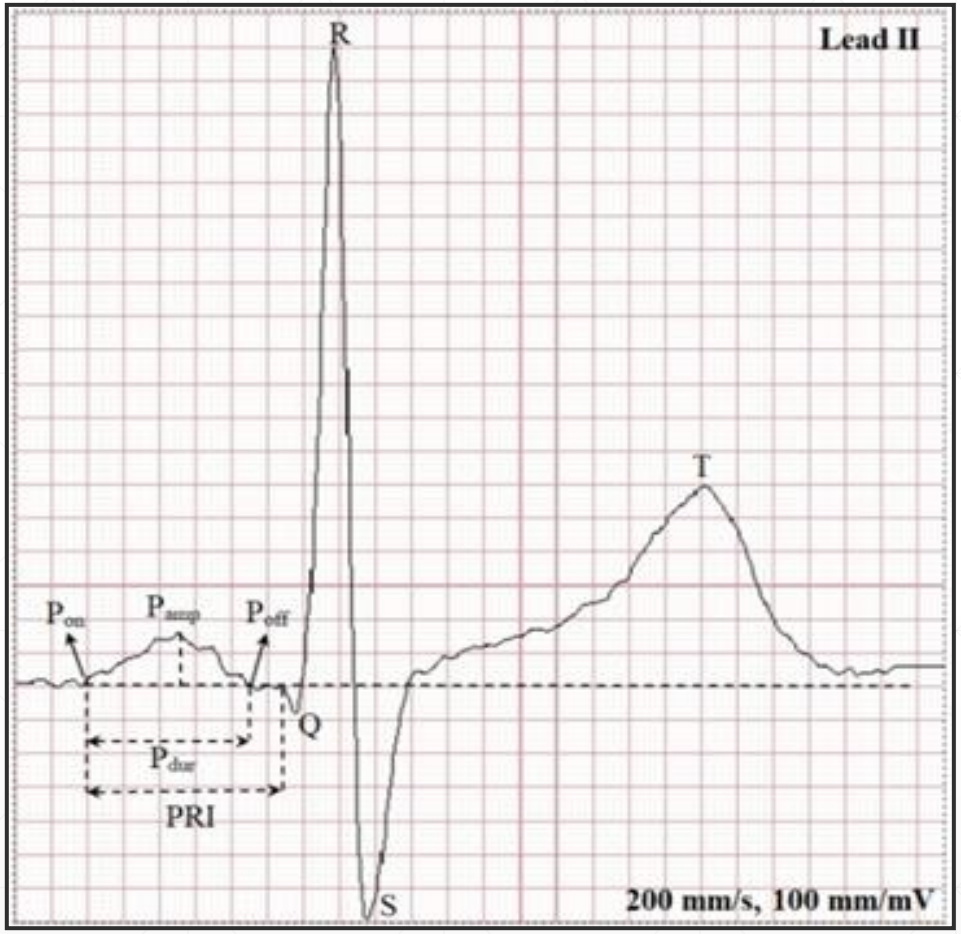

Fig. 1. P wave features in sinus rhythm single beat ECG.

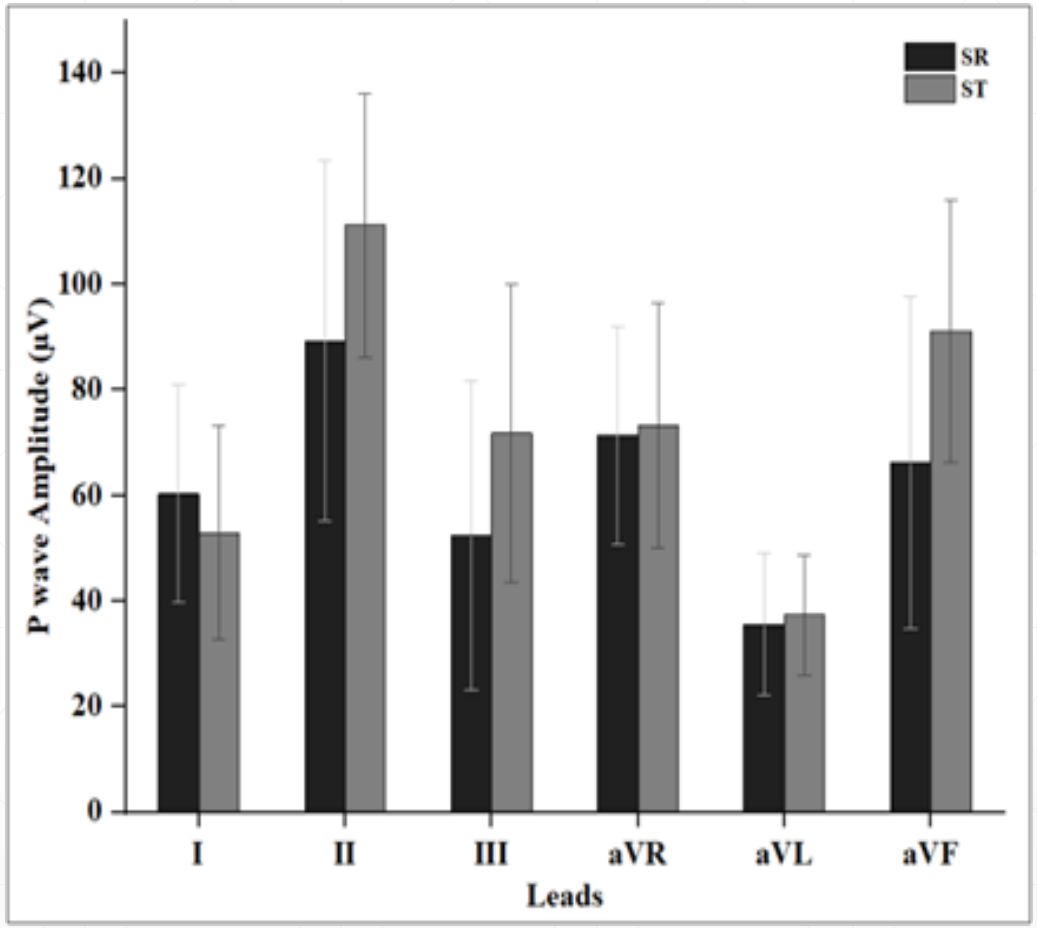

Fig. 2. P wave amplitudes for each lead in SR and ST groups.

TABLE I. P WAVE AMPLITUDE AND AXIS IN SR AND ST GROUPS

Measurements	Limb Leads	SR (n = 50)			ST (n = 25)			P value
		Mean	SD	Min; Max	Mean	SD	Min; Max	
P wave amplitude (µV)	I	60	20.64	23; 125	53	20.22	12;87	< 0.05
	II	89	34.16	17;161	111	25	63;150	< 0.05
	III	52	29.24	15;133	72	28.29	20;143	< 0.05
	aVR	71	20.61	32;142	73	23.24	5;115	< 0.05
	aVL	36	13.46	17;82	37	11.33	17;70	< 0.05
	aVF	66	31.46	15;133	91	24.90	50;145	< 0.05
P wave axis (º)	-	49	17.90	5;90	62	15.38	21;90	< 0.05

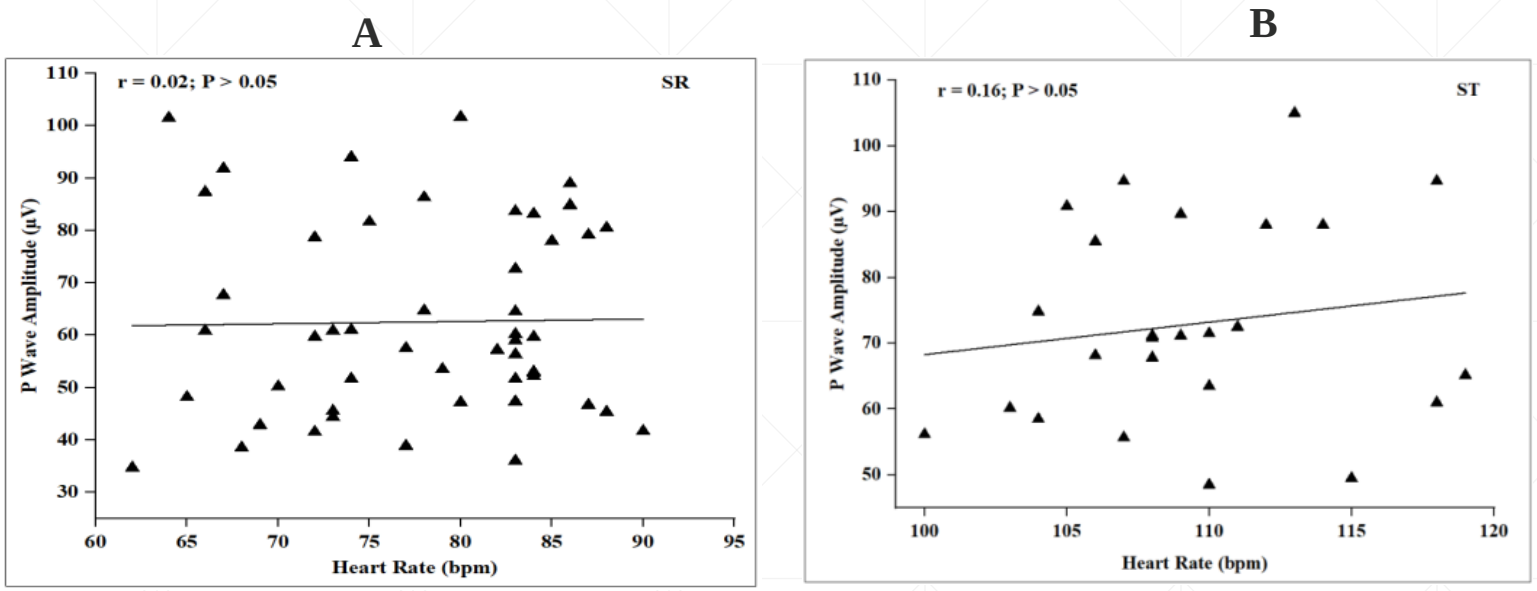

Fig. 3. Relationship of heart rate with P wave amplitude in (A) SR (n = 50) and (B) ST (n = 25).

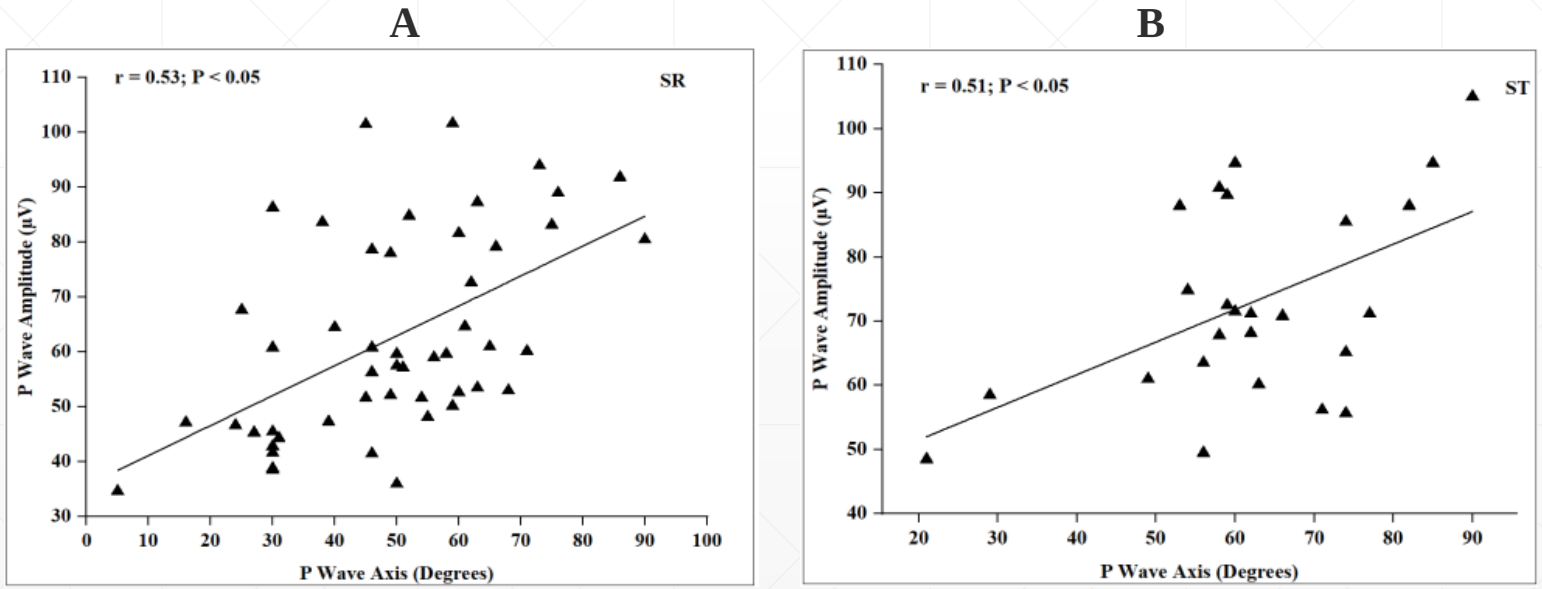

Fig. 4. Relationship of P wave axis with P wave amplitude in (A) SR (n = 50) and (B) ST (n = 25).

TABLE II. HEART RATE AND P WAVE FEATURES IN SR AND ST VOLUNTEERS

Measurements	SR (n=50)			ST (n=25)			P value
	Mean	SD	Min; Max	Mean	SD	Min; Max	
Heart rate (bpm)	78	7.53	62; 90	109	4.84	100; 119	< 0.05
PP interval (ms)	778	78.91	667; 968	550	24.08	504; 600	< 0.05
P wave duration (ms)	96	9.18	72; 116	96	10.01	77; 119	> 0.05
P wave dispersion (ms)	20	11.32	2; 48	13	10.01	3; 45	< 0.05
PR interval (ms)	138	17.60	107; 181	135	18.25	101; 164	> 0.05

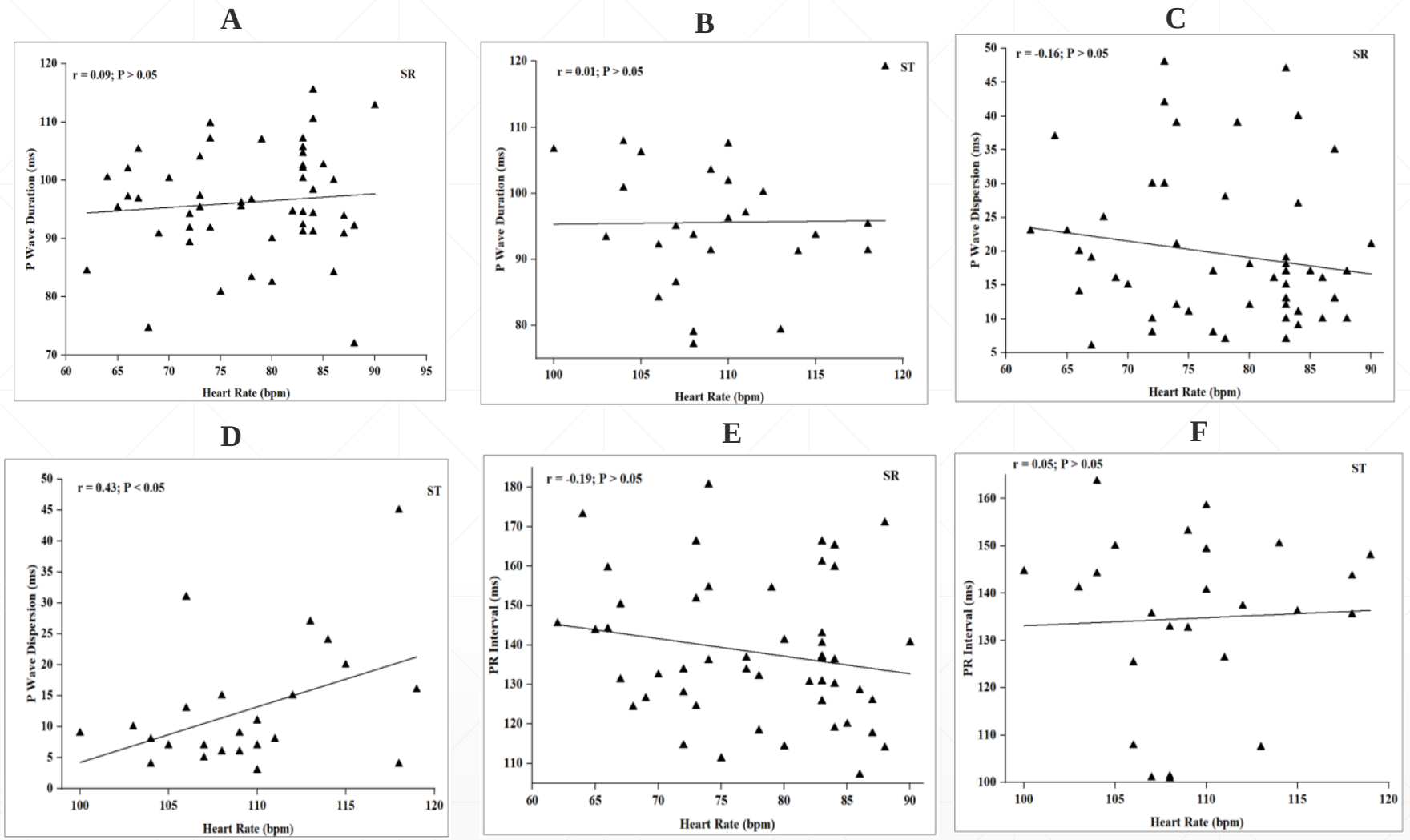

Fig. 5. Correlation of heart rate with P wave duration (A, B), P wave dispersion (C, D) PR Interval (E, F) in SR and ST groups.

Discussion

- **Higher P wave amplitude** in ST volunteers than SR were noted which indicates that increase in heart rate, significantly increase the P wave amplitude [5]. It is also noted that, mean **P wave axis** is higher in ST than SR.

- **Higher variability of P amplitude is noted in SR** compared to ST. It can be reasoned by the study [6] that healthy heart is more dynamic leading to higher heart rate variability compared to diseased heart.

- P wave Dispersion (PD) for ST is lesser than the SR and both the values are within the 40 ms with outliers below 48 ms for both the groups. It is noted from the previous studies that, **PD value increases significantly in atrial tachycardia** condition [7].

- However in this study, the ST volunteers have **lesser PD may be due to the effect of physiological changes**.

Conclusion

- **Higher heart rate** may lead to an **increase in P wave axis**, making atrial depolarization electric mean vector more parallel to lead II; thus, **increasing the amplitude** values.
- Heart rate and PPI are **inversely correlated** with r = -0.9.
- **Healthy heart is more dynamic** compared to during any physiological and pathological conditions.
- More elaborate studies on PD variations in sinus tachycardia can provide the better understanding of heart activity in response to physiological conditions.

Acknowledgment

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Thank You