Electrocardiogram-Assisted Blood Pressure Estimation in Patients with Atrial Fibrillation and other Chronic Conditions

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Background

Blood pressure (BP) is an important vital sign characterizing cardiovascular health. Therefore, BP management through accurate monitoring is critical for reducing risk of life-threatening conditions like stroke and myocardial infarction. Automated non-invasive BP (NIBP) devices are increasingly recommended in clinical practice and home monitoring. However, these devices tend to be unreliable in patients with chronic conditions like atrial fibrillation (AF), atherosclerosis, and obesity [1] – resulting in inefficient BP management and hence increased risk [2]. Unreliability arises because NIBP monitors estimate BP by analyzing arterial pulses alone and these patients may present weak, erratic, and/or unpredictable arterial pulses.

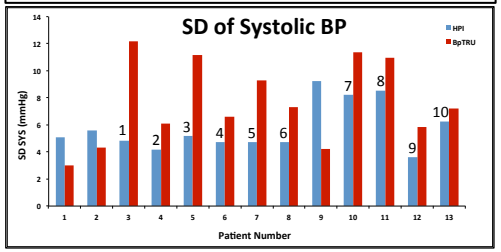
Method

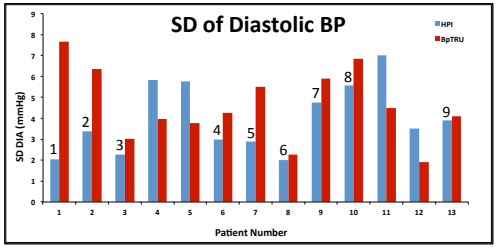
Health Parametrics Inc. (HPI), a University of Ottawa spinoff, is investigating a novel technology for increasing the accuracy and reliability of automatic NIBP estimation. Briefly, we have developed a simple method for simultaneous acquisition of electrocardiogram (ECG) and arterial pulse data within the automatic NIBP monitoring paradigm [3]. Algorithms analyze arterial pulses with the assistance of ECG data, which tends to be less affected by the above conditions, to improve BP estimation accuracy [4-5].

We recently conducted a pilot clinical investigation in which 13 patients (N=13) with chronic conditions including AF and obesity were recruited. For each patient, in about 30 minutes, 6 BP measurements taken by HPI's prototype were compared with 6 BP measurements taken by BpTRU, a commonly used clinical NIBP device (*78 measurements/device for N=13*).

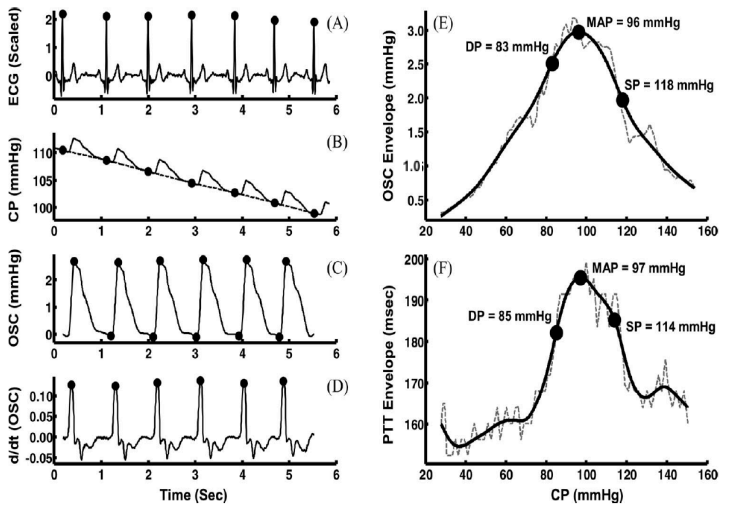
Ottawa (N=13)	
Patient Conditions	**Value**
Atrial Fibrillation (AF) *	9 (69%)
Hypertension *	7 (54%)
Class III Obesity (BMI ≥ 40)	2 (15%)
Class II Obesity (BMI Range: 35–39)	1 (8%)
Hypotension	1 (8%)
Mild AF	1 (8%)
History of Heart Bypass Surgery	1 (8%)
History of Stroke	1 (8%)

** On medication for condition*





Algorithms



Comparison of Mean BP (*t-test*)

N = 13	SYS (Mean ± SD)	Ttest (SYS)	DIA (Mean ± SD)	Ttest (DIA)
HPI	***122 ± 13***	***✓PASSES (p = 0.83, p > 0.05)!***	***72 ± 10***	***✓PASSES (p = 0.43, p > 0.05)!***
BpTRU	***123 ± 14***		***76 ± 12***	

Results

The average systolic and diastolic BP measured by HPI's prototype and BpTRU were not significantly different (Student's t-test, p>0.05). Moreover, standard deviation of systolic and diastolic BP measured by HPI's device was lower than that of BpTRU in 77% and 69% of the patients respectively.

Conclusion

These initial results suggest that HPI's technology has the potential to improve the accuracy/reliability of NIBP measurements in patients with chronic conditions – that may lead to improved BP management and hence reduced risk.

References

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