Validation of blood pressure measurement via Pulse-Transit-Time (PTT) versus the intra-arterial, invasive method in patients with previous cardiological illnesses (Translation of the German Poster)

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Introduction

The continuous blood pressure measurement (BPM) via Pulse Transit Time (PTT) could be an alternative method for non invasive BPM. With cardiological patients, the R wave could be difficult to detect in the ECG and likewise as the detection of the peripheral pulse wave could be a problem. This is especially important for disturbed electrical conduction or hypotonic circulatory conditions.

The objective of this study is to validate PTT as a blood pressure measuring tool for those patients.

Method

From the ECG signal the R peak of a heart contraction is detected and defined as the beginning of a pulse wave. Peripherally, the pulse wave is detected by the finger clip of a photoplethysmograph. Thanks to the derived PTT the pulse wave velocity can be measured. The quicker the pulse travels, the higher the vessel wal tension, and the higher the blood pressure. The other way round, the slower the pulse travels, the lower the vessel wall tension and the lower the blood pressure.

For this BPM a Somnoscreen plus was used (SOMNOmedics, Randersacker). The device is calibrated once at the start of the recording. The blood pressure measurement lasted one hour; with values taken every 30 seconds.

The statistical analysis is carried out with "Mixed-Effects Models for Replicated, Blocked Designs". The calculation is done with "R", Version 2.9.2.

For a more precise analysis, the patients were split into groups.
Group1: Non-Hypertension patients without arrhythmia.
Group 2: Patients with Hypertension at the beginning of recordings
Group 3: Patients with arrhythmia

Demography and clinical data (Table 1)

Quantity (Percent) as the case may be average value (+- Std. deviation)

Parameters	Sum	Group 1	Group 2	Group 3
Patient	40 (100%)	10 (25%)	8 (20%)	22 (55%)
Sex (m/w)	29 (72,5%) /11 (27,5%)	9 (22,5%) /1 (2,5%)	6 (15%) / 2 (5%)	14 (35%) /8 (20%)
Age in Years	68,7 (±15)	64,7 (±16,9)	61,5 (±21,8)	73,1 (±9,33)
Height in cm	173 (±10,1)	174 (±9,78)	173 (±10,66)	172 (±9,96)
Weight in kg	79 (±16,42)	87 (±22,28)	73 (±14,76)	78 (±11,98)
BMI - Mean	26,6 (±5,36)	28,5 (±7,04)	24,2 (±2,88)	26,5 (±4,77)
Mechanical Ventilation	10 (25%)	2 (5%)	3 (7,5%)	5 (12,5%)
Cathecholamine intake	20 (50%)	5 (12,5%)	4 (10%)	11 (27,5%)

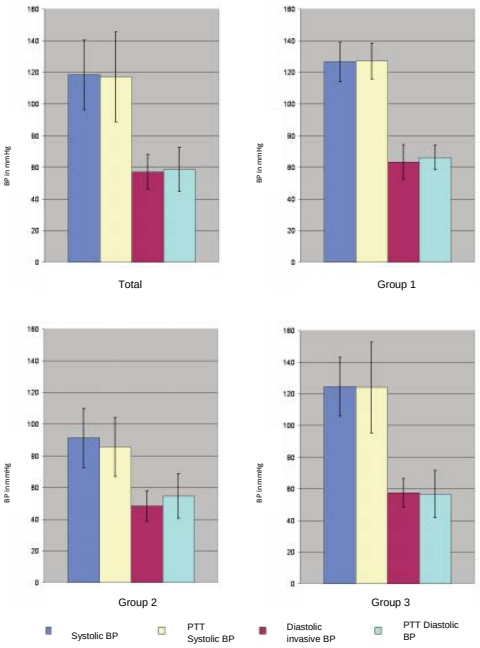
Blood pressure recording (Table 2) Quantity (Percent)

Parameter	Sum	Group 1	Group 2	Group 3
	4800 (100%)	1200 (100%)	960 (100%)	2640 (100%)
BPM sys. Invasive	4755 (99,06%)	1194 (99,5%)	954 (99,38%)	2607 (98,75%)
BPM dia. Invasive	4752 (99%)	1194 (99,5%)	953 (99,27%)	2605 (98,67%)
BPM sys. PTT	4136 (86,17%)	1145 (95,42%)	731 (76,15%)	2260 (85,61%)
BPM dia. PTT	4137 (86,19%)	1145 (95,42%)	731 (76,15%)	2261 (85,64%)

Analysed data and results (Table 3) obtained BPM values

Parameters	Sum	Group 1	Group 2	Group 3
	9600 (100%)	2400 (100%)	1920 (100%)	5280 (100%)
BPM systolic	8891 (92,61%)	2339 (97,46%)	1685 (87,76%)	4867 (92,18%)
BDM diastolic	8889 (92,59%)	2339 (97,46%)	1685 (87,76%)	4866 (92,16%)
p-values systolic	0,5131	0,8382	0,1396	0,763
p-values diastolic	0,3812	0,2191	0,1253	0,8713

Recording Results (Figure 1)



Recording Results (Table 4 to figure 1)

Blood Pressure (BP) and average arterial pressure (AAP) in mmHG

Parameters	Sum	Group 1	Group 2	Group 3
BP sys. Invasive	118,42 (±22,08)	126,67 (±12,46)	91,22 (±18,89)	124,56 (±18,66)
BP sys. PTT	117,16 (±28,45)	127,16 (±11,39)	85,54 (±18,61)	124,11 (±28,8)
BP dia. Invasive	57,13 (±10,9)	63,33 (±10,92)	48,34 (±9,77)	57,51 (±9,02)
BP dia. PTT	58,67 (±14,03)	66,22 (±7,83)	54,70 (±14,13)	56,69 (±14,89)
AAP (calculated)	77,56 (±13,24)	84,44 (±10,91)	62,63 (±12,01)	79,86 (±10,22)

Conclusion

A continuous blood pressure recording with Pulse Transit Time (PTT) over an hour delivers similar values for cardiological patients as intra-arterial blood pressure measurement.

In some patients however it is not possible to get blood-pressure values from PTT for a long time of the recording. In those cases, continuous recording is not advised.

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