Invasive validation of central blood pressure measurements using a suprasystolic monitor

SCALIA Alessandro[1], **GHAFARI** Chadi[1], **SCOTT**, Richard[2],**ROCHD** Medhi[1], **PHILLIPS** Rob[4], **CARLIER** Stéphane[1]

[1] CHU HELORA-Site Kennedy, Mons, Belgium, [2] R&D Department, Uscom, Australia; [3] Cardiology department, University of Mons, Mons, Belgium, [4]The University of Queensland, Brisbane, Australia

Background :

Interest in the assessment of **Central Blood Pressure (cBP)** is steadily growing since it is a better predictor of myocardial infarction, stroke, or cardiovascular death than Peripheral Blood Pressure (pBP). However, pBP remains the first line for the diagnosis and follow-up of hypertension due to the simplicity of the measurements.

Objectives :

We sought to validate a new method to non-invasively estimated cBP from brachial sphygmomanometer measurements.

Methods :

We estimated cBP after conventional pBP measurement, using a sphygmomanometer that can record 10s of pressure in the cuff maintained at a constant suprasystolic pressure. The cBP waveform is calculated using a physics-based model of wave-reflection in the left subclavian and brachial arteries. We compared this noninvasively estimated cBP to an invasive gold-standard micromanometer-tip 0.014" catheter during cardiac catheterization. After clinically indicated cardiac catheterization requiring a haemodynamic assessment of a moderate coronary artery stenosis by Fractional Flow Reserve (FFR), the wire that incorporates a high-fidelity electronic pressure transducer (micromanometer) was positioned into the guiding catheter left in the ascending aorta.

Simultaneous measurements were performed with a cuff placed on the patient's left arm. The output signals were recorded in a customized A/D acquisition system previously described[1]. The comparison was performed on the same 10 second samples recorded by the cuff by the BP+ (Uscom Ltd., Sydney, NSW, Australia) and the pressure wire (Comet, Boston Scientific).

Patients with an aortic stenosis, atrial fibrillation, or frequent (supra)ventricular extrasystoles were excluded.

We adopted the ARTERY Society Task Force recommendations for acceptable validation criteria of a mean difference ≤ 5 mmHg with a standard deviation (SD) ≤ 8 mmHg [2].

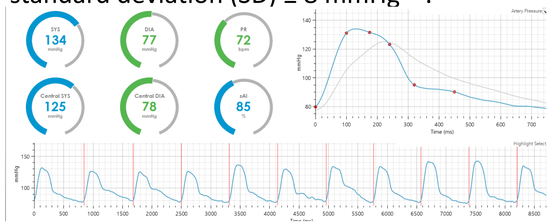

*Figure 1. Brachial and estimated central BP from the central suprasystolic monitor BP+ (*Uscom Ltd., Sydney, NSW, Australia)

Results :

In 96 patients, a total of 234 pairs of measured-estimated cBP were analysed.

The 95% confidence interval **invasively measured cBP was 118 [100 - 136] / 66 [56 - 76] mmHg while estimated cBP was 114 [98 - 130] / 71 [61 – 81] mmHg.**

The mean difference between estimated and measured systolic cBP was 4.7±6.3 mmHg, while it was -4.8±5.5 mmHg for diastolic cBP, complying with ARTERY task force

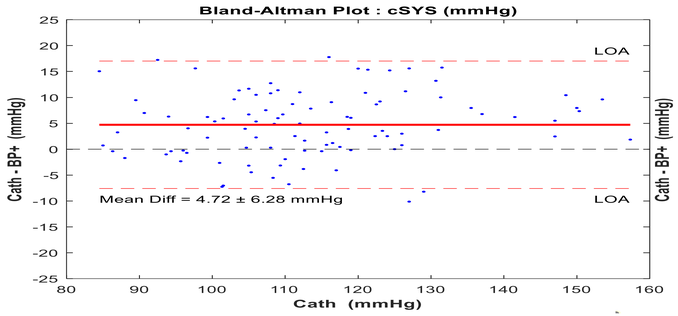

Figure 2. Bland Altman scatterplot of measured-estimated systolic cBP demonstrating a small mean difference of 4.7 mmHg.

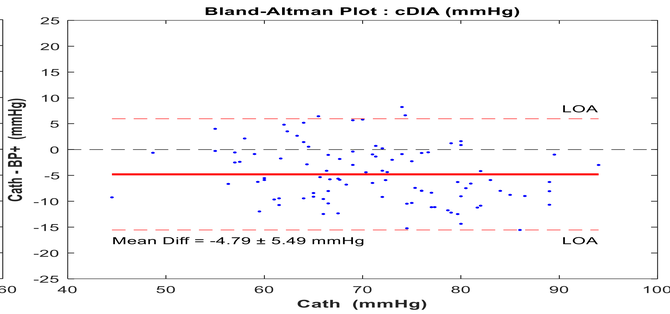

Figure 3. Bland Altman scatterplot of measured-estimated diastolic cBP demonstrating a mean difference of -4,8 mmHg.

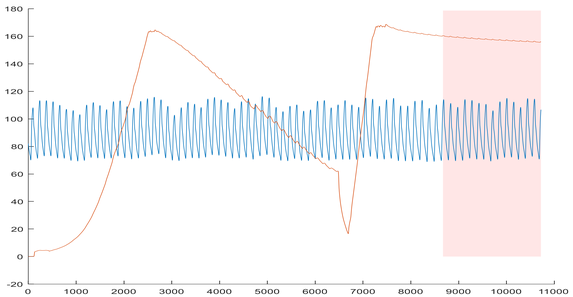

Figure 4. Invasive Catheter pressure recording time aligned with BP+ oscillometric measurement. Shaded portion 10s simultaneous suprasystolic region used to estimate cBP.

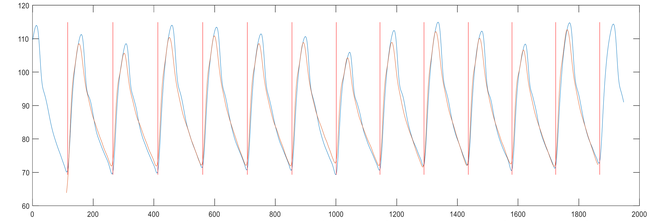

Figure 5. Invasive catheter pressure in blue and BP+ estimated cBP in red.

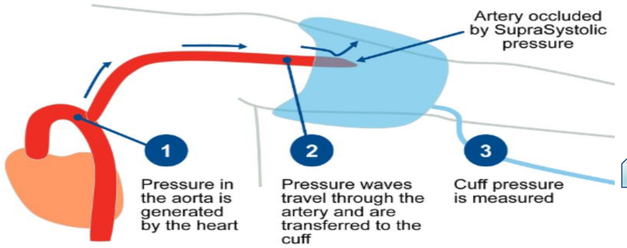

Figure 6. Representation of the suprasystolic method of the cBP: estimation through the device using the pBP as a reference to derive the cBP.

Conclusion :

We validated non-invasive BP+ suprasystolic measurements meeting ARTERY criteria using gold standard micromanometer high-fidelity invasive aortic blood pressure measurements as the reference. We believe this is the first device to attain this high level of validation. BP+ (USCOM) enables non-invasive assessment of central aortic blood pressure easily carried out in daily practice.

References :

[1] Scalia, A.; Ghafari, C.; Navarre,W.; Delmotte, P.; Phillips, R.; Carlier, S. High Fidelity Pressure Wires Provide Accurate Validation of Non-Invasive Central Blood Pressure and Pulse Wave Velocity Measurements. Biomedicines 2023, 11, 1235.https://doi.org/10.3390/biomedicines11041235

[2] Sharman, J.E.; Avolio, A.P.; Baulmann, J.; Benetos, A.; Blacher, J.; Blizzard, C.L.; Boutouyrie, P.; Chen, C.-H.; Chowienczyk, P.; Cockcroft, J.R.; et al. Validation of non-invasive central blood pressure devices: ARTERY Society task force consensus statement on protocol standardization. Eur. Heart J. 2017, 38, 2805–2812