TACSM Abstract

Can We Calculate Mean Arterial Pressure in Humans?

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ABSTRACT

Mean arterial pressure (MAP) is either measured with an oscillometric cuff and then systolic (SBP) and diastolic (DBP) blood pressures are estimated from an unknown algorithm; or SBP and DBP are measured via auscultation and MAP calculated using measures of systolic pressure (SBP), diastolic pressure (DBP), and a form-factor (FF; equation: [(SBP-DBP)*FF]+DBP). The typical FF used is 0.33 though others (0.4) have been proposed. Recent work indicates that estimation of aortic MAP via a FF leads to inaccurate values and should therefore be interpreted with caution, whether this is the case for local MAP is unknown. While the implications for hypertension (HTN) diagnosis are minimal, the calculation of local MAP is essential to the study of blood pressure regulation and exercise hemodynamics in patient populations (e.g. heart failure). **PURPOSE:** To compare the calculation of local MAP using catheter waveforms and a FF, against MAP derived from the pressure-time integral (PTI; i.e. average pressure across the cardiac cycle) measured via radial arterial catheterization. **METHODS:** We analyzed radial arterial catheter waveforms from 39 patients (Age: 71±7 years; BMI: 38.4±6.7; Female: 66%; HTN prevalence: 97%) with heart failure with preserved ejection fraction (HFpEF) at rest and during cycling exercise at 20 Watts. We compared the PTI (from the catheter waveform) with the calculation of MAP from the peak and nadir of the same waveforms (5-beat averages) using the 0.33 and 0.4 FF's in the FF equation. **RESULTS:** Compared to the PTI (91±13 mmHg), resting MAP was not significantly different when calculated using the 0.33 FF (91±11 mmHg, P>0.999) but was higher when using the 0.4 FF (96±12 mmHg, P<0.001). MAP was not different during exercise when using the PTI and 0.33 FF (P=0.989), whereas 0.4 overestimated MAP (P<0.001). Bland-Altman analysis of PTI and the calculated MAPs revealed marked variability for both the 0.33 (Rest: 0.0 mmHg [-6.4 to +6.4]; 20 Watts: 0.2 mmHg [-7.8 to +8.3]; Bias [95% Limits of Agreement]) and 0.4 FF's (Rest: 5.5 mmHg [-1.5 to +12.5]; 20 Watts: 7.5 mmHg [-1.4 to +16.5]). The required FF to calculate the PTI MAP ranged from 0.22-0.42 at rest and 0.20-0.39 at 20 Watts; the required FF was the same for rest and exercise in only 10% (n=4) individuals. **CONCLUSION:** While the 0.33 FF provides an accurate assessment of MAP on average during rest and exercise in the radial artery in patients with HFpEF, the limits of agreement are large reflecting a lack of precision in measurement at an individual level. Indirect calculations of MAP via a FF may lead to inaccurate conclusions regarding the mechanisms of blood pressure regulation both at rest and during exercise testing in this population.