Effect of Talking on Mean Arterial Blood Pressure: Agreement between Manual Auscultatory and Automatic Oscillometric Techniques

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Abstract

This study aimed to provide quantitative clinical data on the comparison of the effect of talking on both manual and automatic blood pressure (BP) measurements.

Manual auscultatory systolic and diastolic blood pressures (SBP and DBP) were obtained from 20 healthy subjects under resting and talking conditions. During the measurement the oscillometric cuff pressure was also recorded digitally. Manual mean arterial pressure (MAP) was calculated from the empirical equation. Automated MAP was determined from the peak of the 6th order polynomial model envelope fitted to the sequence of oscillometric pulse amplitudes. The effect of talking on both manual and automated MAPs was then quantified and compared.

Talking increased both manual and automated MAPs significantly by 5.4 mmHg and 5.2 mmHg respectively in comparison with those from the resting condition (both P<0.001). The increases of manual and automated MAPs were moderately correlated with a regression slope of 0.87 and R square value of 0.4.

Our results provide scientific support for measurement protocols asking subjects not to talk during the measurement.

1. Introduction

It is well accepted that blood pressure (BP) measurement accuracy is associated with the conditions in which BP measurement is taken. In clinical practice, talking is one of the commonest measurement disturbances influencing BP measurement accuracy [1-3].

To achieve accurate BP measurement, several international organisations, including the American Heart Association (AHA) [1], the British Hypertension Society (BHS) [2] and the European Society of Hypertension (ESH) [3], highly recommend that talking must be avoided during the BP measurement procedure, no matter whether the BPs are taken by manual or automatic measurement techniques.

Our own previous studies have quantified the effect of talking on manual auscultatory BPs. Increased manual auscultatory systolic and diastolic blood pressures (SBP and DBP) were observed [4, 5]. The automated BP increase with talking was also reported with the measurements taken from different automatic BP devices [6, 7]. These BP increases with talking may result in some normotensive subjects being wrongly diagnosed and wrongly treated.

However, there is little quantitative clinical data available on the comparison of the effect of talking on both manual and automatic techniques. Providing these data would help in understanding the underlying mechanism of the effect of talking on BPs.

2. Methods

2.1. Subjects

Twenty healthy subjects, with no known cardiovascular disease, were studied. There were 15 male and 5 female subjects, with ages in the range of 27 to 64 years. The detailed subject demographic information including age, height, weight and arm circumference are summarized in Table 1. This study received ethical permission, and all subjects gave their written informed consent to participate in the study.

Subject information		
No. subjects	20	
No. male	15	
No. female	5	
	Mean	**SD**
Age (years)	44	13
Height (cm)	173	9
Weight (kg)	75	11
Arm circumference (cm)	28	3

Table 1. Demographic data for the subjects studied. Their means and standard deviations (SDs) are presented.

2.2. Blood pressure measurements

BP measurements were undertaken in a quiet clinical measurement room. Prior to the measurement, the subject was asked to have a 5 min rest in order to allow cardiovascular stabilization. The subject was then seated in a chair with their feet on the floor and with arm supported at heart level. The whole BP measurement procedure followed the guidelines recommended by the American Heart Association [1].

Manual auscultatory SBP and DBP were obtained by a trained observer using a clinically validated electronic sphygmomanometer (Accoson Greenlight 300 from AC Cossor & Son (Surgical) Ltd) [8]. For each subject, three repeat BP measurement sessions were performed, with two BP measurements in each. One was measured under resting condition and the other under talking condition (counting numbers).

During the measurement, the oscillometric cuff pressure was deflated at the recommended deflation rate of 2-3mmHg/s and recorded digitally to a data capture computer at a sample rate of 2000 Hz.

2.3. Mean arterial pressure determination

Manual mean arterial pressure (MAP) was estimated from manual DBP plus one third the pressure change from DBP to SBP.

Automated MAP was determined from the cuff pressure at a specific time using interactive software developed with Matlab 7.1 (MathWorks Inc. USA). A 6th order polynomial curve was used to fit to the sequence of oscillometric pulse peaks. Automated MAP was then determined from the cuff pressure corresponding to the peak of the model envelope. Figure 1 illustrates the model-based automated MAP determination technique.

2.4. Data and statistical analysis

The average manual and automated MAPs from the three repeat sessions were used as the reference value for that subject. The mean and SD of the manual and automated MAPs across all subjects were calculated, separately for the resting and talking conditions.

The SPSS Statistics 17 software package (SPSS Inc., USA) was then employed to perform paired t-test to investigate the effect of talking on both manual and automated MAPs, and also perform the regression analysis between the changes of manual and automated MAPs with talking. The regression slope and the square of the correlation coefficients (R square) were also obtained. A P value below 0.05 was considered statistically significant.

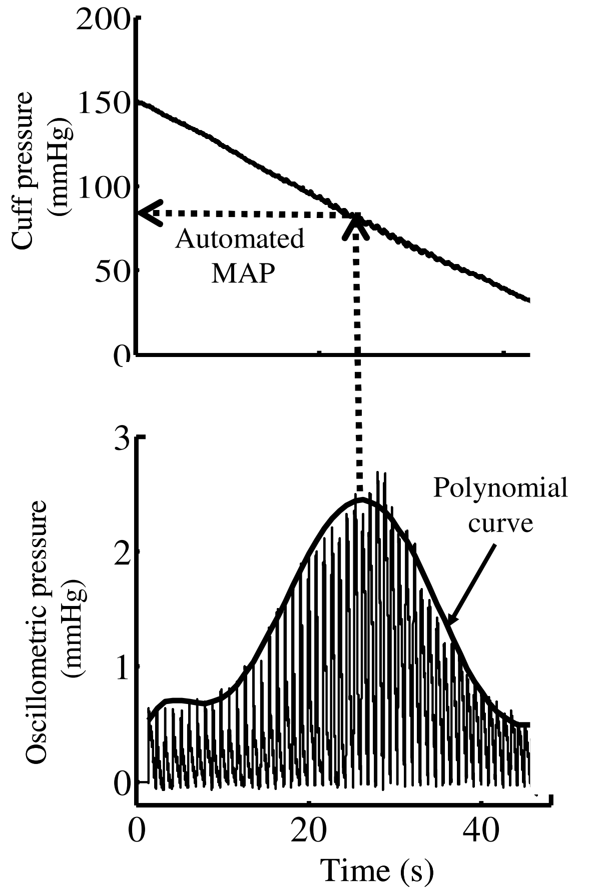

Figure 1. Illustration of the model-based automated MAP determination.

3. Results

3.1. Effect of talking on manual systolic and diastolic pressures

Table 2 shows the overall means of manual SBP and manual DBP calculated from all subjects separately for resting and talking conditions. Both manual SBP and DBP increased significantly by 4.4 mmHg and 5.8 mmHg respectively with talking in comparison with that for the resting condition (both P<0.001).

	Measurement conditions	
	Resting	Talking
Manual SBP (mmHg)	115.3 ±9.6	119.7±9.9*
Manual DBP (mmHg)	76.9±6.5	82.7±6.2*

Table 2: Overall mean±SD of manual SBP and DBP measured under resting and talking conditions.

*: Significant increase in comparison with the resting condition (P<0.001).

3.2. Effect of talking on manual and automated mean arterial pressures

Talking increased both manual and automated MAPs significantly by 5.4 mmHg (mean±SD: 89.6±6.6 vs 94.9±6.9 mmHg) and 5.2 mmHg (86.6±7.7 vs 91.8±8.1 mmHg) respectively in comparison with those from the resting condition (both P<0.001), which is shown in Figure 2. Figure 3 shows that the manual MAP increase with talking was not significantly different from that for automated MAP (P=0.8).

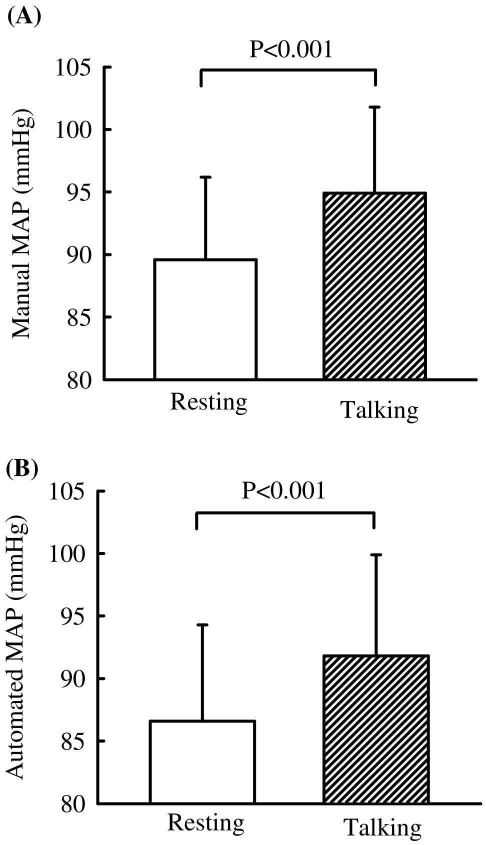

Figure 2. Overall mean±SD of manual (A) and automated (B) MAPs measured under resting and talking conditions.

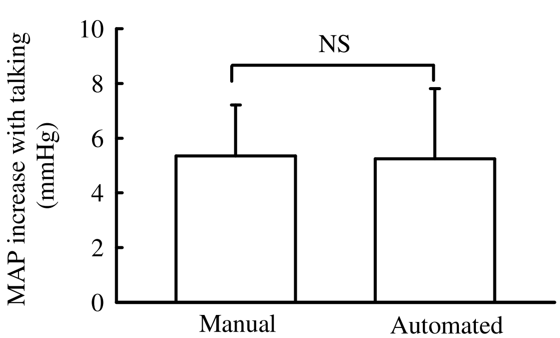

Figure 3. Comparison between manual and automated MAP increases with talking.

To visualise the underlying principle of the automated MAP increase with talking, Figure 4 gives one oscillometric waveform example showing a shift of the peak of the modeled 6th order polynomial curve to higher pressures when the BP measurement was taken under talking condition, hence the higher MAP was obtained.

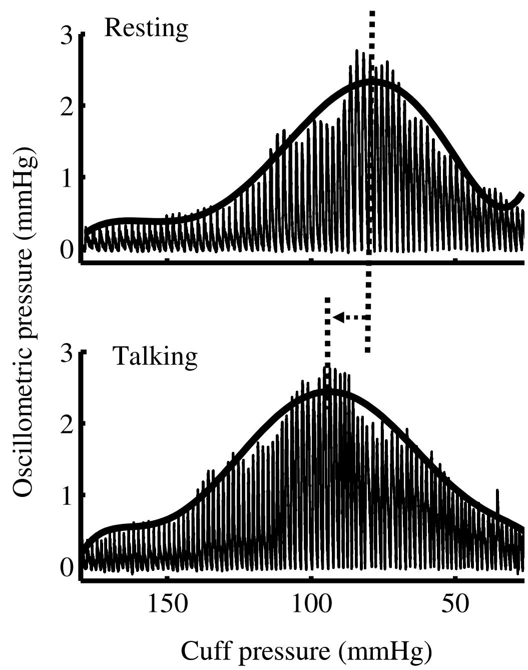

Figure 4. Illustration of a shift of the oscillometric pulse waveform envelope peak to higher pressures with talking.

3.3. Relationship between changes of manual and automated mean arterial pressure with talking

Figure 5 shows the relationship between the increases of manual and automated MAP with talking. It is shown that they were moderately correlated with a regression slope of 0.87 and R square value of 0.4.

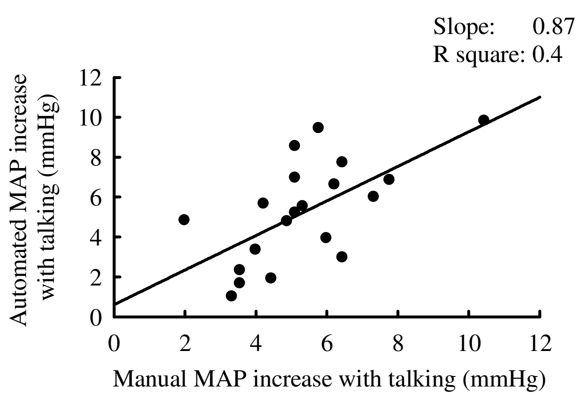

Figure 5. Relationship between manual and automated MAP increases with talking.

4. Discussion and conclusion

In this study, we have shown that talking (counting numbers) had a significant influence on the measured manual and automated MAPs. When compared with the resting condition, significantly higher manual and automated MAPs were obtained. These quantitative findings further emphasize the importance of carefully controlling the measurement conditions under which BP is taken.

Furthermore, we have also shown that, by analysing the recorded oscillometric pulse waveform, an increase in manual auscultatory MAP with talking has been confirmed with a shift of the peak of the oscillimetric pulse waveform envelope to higher pressures. This provides scientific support for measurement protocols asking subjects not to talk during the measurement, and is also an important step to better understand the underlying mechanism of the BP increase with talking.

Acknowledgements

Dingchang Zheng and Roberto Giovannini were funded by the Engineering and Physical Sciences Research Council (EPSRC).

References

[1] Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN et al. Recommendations for blood pressure measurement in humans and experimental animals. Part 1: Blood pressure measurement in humans. A statement for professionals from the subcommittee of professional and public education of the American Heart Association Council on high blood pressure research. Hypertension 2005; 45: 142-161.

[2] Williams B, Poulter NR, Brown MJ, Davis M, McInnes GT, Potter JF et al. British Hypertension Society. Guidelines for Management of Hypertension: Report of the Fourth Working Party of the British Hypertension Society. J Hum Hypertens 2004; 18: 139-185.

[3] O'Brien E, Asmar R, Beilin L, Imai Y, Mallion JM, Mancia G et al. European Society of Hypertension recommendations for conventional, ambulatory and home blood pressure measurement. J Hypertens 2003; 21: 821-848.

[4] Smith FE, Haigh A, Wild J, Bowers EJ, King S, Allen J et al. Study of the causes of blood pressure variability during manual sphygmomanometer measurement. IFMBE Proc 2005; 9: 95-96.

[5] Zheng D, Giovannini R, Murray A. Effect of respiration, talking and small body movements on blood pressure measurement. J Hum Hypertens (26 May 2011), doi : 10.1038/jhh. 2011.53.

[6] Le Pailleur C, Helft G, Landais P, Montgermont P, Feder JM, Metzger JP et al. The effects of talking, reading, and silence on the "white coat" phenomenon in hypertensive patients. Am J Hypertens 1998; 11: 203-207.

[7] Le Pailleur C, Montgermont P, Feder JM, Metzger JP, Vacheron A. Talking effect and “white coat” effect in hypertensive patients: physical effort or emotional content? Behav Med 2001; 26:149-157.

[8] Graves JW, Tibor M, Murtagh B, Klein L, Sheps SG. The Accoson Greenlight 300TM, the first non-automated mercury free blood pressure device to pass the International Protocol for blood pressure measuring devices in adults. Blood Press Monit 2003; 9: 13-7.

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