

Variability Between Initial and Subsequent Measurements of Noninvasive Blood Pressure

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Introduction

The use of NIBP monitoring as a basis for intraoperative management relies upon consistent measurements for each individual patient. The purpose of our research was to analyze trends of deviation between initial and subsequent NIBP measurements in order to evaluate the reliability of using the first NIBP measurement as a basis for intraoperative management. Our casual observation was that the first NIBP measurement was always higher than the second reading, thus we undertook a formal preliminary study to determine if this phenomenon is real. In this study, we controlled for such variables that are known to distort NIBP monitoring, such as inappropriate cuff size, in which “undercuffing” yields falsely high pressures, while the opposite effect occurs with “overcuffing” (Pickering et al. 2005). Additionally, we collected data in a controlled environment from participants who were not subject to anesthesia or surgical stimulation. Lastly, we sought to determine if our observation of the first systolic measurement being higher than the second reading was consistent among multiple NIBP module manufacturers.

Materials & Methods

For this exploratory project six subjects were chosen from students and instructors without regard to age, illness, medication, or sex. Subjects were told to lie down in the supine position where an appropriate sized NIBP cuff was applied to the upper arm. NIBP settings were then prepared wherein the “new patient” option, as well as a cycle interval time of 3 minutes were selected. The first NIBP was then measured followed by five subsequent measurements. To ensure that any phenomenon discovered was not merely a function of the machine, the aforementioned steps were performed for each subject on three separate monitors including the GE Carescape B850 , the Philips Intelliview MX800 , as well as Drager’s Infinity M540 monitor. Subjects were required to wait a minimum of one day in between each monitor’s data set to ensure that the vascular integrity was comparable from one monitor to another. A paired t test was performed on each paired difference measurement. SigmaPlot was used for all data analysis.

References

Pickering TG, Hall JE, Appel LJ, et al. AHA Scientific Statement: Recommendations for blood pressure measurement in humans and experimental animals, part 1: blood pressure measurement in humans. Hypertension. 2005; 45: 142-161. (Available at: <https://hyper.ahajournals.org/content/45/1/142.full>)

Longnecker D, Brown D, Newman M, Zapol W. Anesthesiology. 1st ed. China: McGraw Hill; 2008. 519 p.

Results

In this experiment six systolic, diastolic and mean pressure measurements were obtained from subjects on three different monitors on separate occasions. While there were significant differences between the initial and second measurements, the differences are not clinically significant (Table 1). There were no significant differences between mean differences of the second or third or subsequent measurements.

Table 1: Mean differences between the initial measurement and the second measurement from each of the three monitors. All initial measurements were greater than the second measurements that followed 3 minutes later.

	GE Carescape B850	Philips Intelliview MX800	Drager Infinity M540
Mean Difference between initial and second measurement	7 mmHg	5.2 mmHg	6.5 mmHg
Statistical Significance	Two tailed paired t test P = 0.000209	Two tailed paired t test P = 0.0151	Two tailed paired t test P = 0.0126

Conclusion

These preliminary results have demonstrated that the initial measurements are significantly elevated from the second measurements on all subject and all monitors. Patient monitors from different manufacturers were used under the assumption that different manufacturers have different algorithms for computing systolic, diastolic and mean pressures, although they are all based upon oscillometric principles (Longnecker et al). If algorithms are different, then the underlying cause may be related to mechanics of vascular physiology. Further studies are needed to identify the possible reason for elevated initial systolic pressures.