Title: SYSTOLIC BLOOD PRESSURE MEASUREMENT: DOPPLER VS. PULSE OXIMETER

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Introduction: Pulse oximeters are increasingly used for the routine monitoring of oxygen saturation in patients undergoing anesthesia. The ability of the oximeter to sense arterial pulsations suggests its use in measuring systolic blood pressure as well. The purpose of this study was to compare the accuracy of the pulse oximeter for the determination of systolic blood pressure versus the standard Doppler ultrasound technique.

Methods: Institutional approval and informed consent for the study were obtained. The study was performed in two phases. Ten healthy subjects ages 31±2 SD with normal body habitus underwent measurement of their systolic BP utilizing an appropriately sized BP cuff attached to a mercury manometer and a Doppler ultrasound flow probe (Parks Electronics) placed over the ipsilateral radial artery. The cuff was inflated until the Doppler sounds were absent and then deflated at the rate of 2 mmHg/sec until pulsations were restored. The cuff pressure at which this occurred was recorded (Doppler systolic BP). A Nelcor pulse oximeter sensor (Nelcor Corporation) was then placed on the ipsilateral index finger and held steady until arterial pulsation sensing and oxygen saturation readings were stable. The cuff was inflated until arterial pulsations were no longer sensed and the cuff deflated as before. The cuff pressure at which arterial pulsations were again sensed (Nelcor descending pressure) was recorded. The cuff was then deflated completely and, after a 15 sec rest period, reinflated at the rate of 2 mmHg/sec until arterial pulsation sensing ceased and the cuff pressure at which this occurred was recorded (Nelcor ascending pressure). Finally, a repeat Doppler systolic pressure was measured. The four sets of BP measurements were compared using ANOVA.

In the second phase of the study, 18 patients undergoing general anesthesia had BP cuff, Doppler, and pulse oximeter probes placed as previously described. Upon induction, and during the course of anesthesia, the cuff was inflated at the rate of 2 mmHg/sec and the Nelcor ascending and Doppler BP's recorded. Additionally, an ICU patient with a direct arterial systolic BP of 30 mmHg was also studied. In all, 65 BP determinations were recorded in 19 patients. The Nelcor ascending and Doppler systolic BP measurements were compared using the Pearson correlation coefficient.

Results: The initial comparison of Doppler and Nelcor ascending and descending BP measurements in volunteer subjects revealed that the descending technique was inaccurate (Fig. 1). Values averaged 20 mmHg below the other techniques (P<.0003). For this reason, only the ascending technique was utilized for the second, clinical, phase of the study. The Doppler systolic pressure was noted to be the same whether measured during cuff inflation or deflation. Comparison of simultaneous Nelcor ascending and Doppler systolic BP determinations showed excellent correlation (R=0.997, Fig 2.) over a wide range of systolic pressures.

Discussion: The Doppler technique of indirect systolic BP measurement has been shown to correlate well with direct arterial pressure determination.[1-2] Our data suggest that the pulse oximeter offers a reasonable alternative to the Doppler for the determination of systolic BP when used appropriately. The inaccuracy of the descending technique was most likely due to the time lag before arterial pulsations were displayed as a result of error rejection algorithms performed by the Nelcor oximeter. The Nelcor ascending BP technique is quite accurate, making it suitable for clinical use.

Figure 1

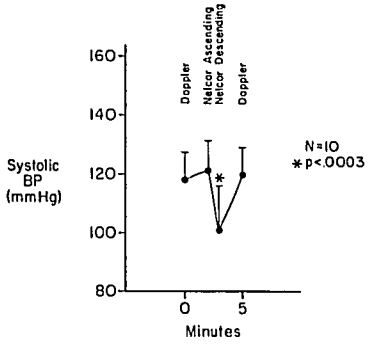
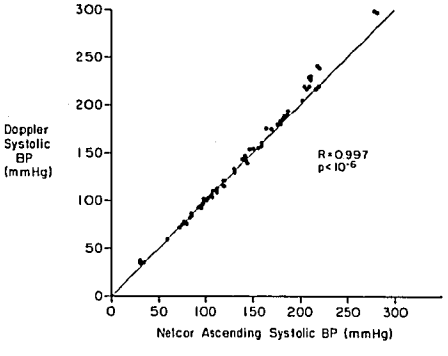


Figure 2



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1. Kemmerer WT, Ware RW, Stegall HF, Evans W: Indirect measurement of human blood pressure by the Doppler ultrasonic technique. Surg Forum 18:163-165, 1967

2. Kirby RR, Kemmerer WT, Morgan JC: Transcutaneous Doppler measurement of blood pressure. Anesthesiology 31:86-89, 1969

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