Title: INTRAOPERATIVE OSCILLOMETRIC ARTERIAL BLOOD PRESSURE MONITORING USING NON-STANDARD CUFF LOCATIONS

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Introduction: Oscillometric arterial blood pressure monitoring devices have found widespread use in operating and recovery rooms. At most institutions, the cuff for these instruments is placed around the patient's upper arm. However, some patients should not have a cuff placed at this location because of the presence of dialysis shunts, intravenous catheters, burns, trauma, or the surgical site. In these patients it may be necessary to place the cuff in an alternative location. Unfortunately, the relationship between pressures obtained at an alternate site and the standard location on the upper arm is unknown. We therefore compared oscillometric arterial blood pressure measurements made using non-standard cuff locations with those obtained simultaneously from the proximal right arm.

Methods: Institutional approval was obtained from the Human Studies Committee. A total of 31 patients scheduled for elective surgery under general anesthesia participated after having given informed consent. Prior to the induction of anesthesia, 2 blood pressure cuffs were placed on each patient. One was placed around the patient's proximal right arm and considered "standard". The second cuff was located on either the proximal left arm, thigh, calf, forearm, or index finger. Care was taken to ensure that a cuff of appropriate size was utilized for each site. Blood pressure was determined simultaneously from both sites using 2 Critikon 1846 Adult/Pediatric Vital Signs Monitors (Critikon Inc., Tampa, FL) that had been calibrated against a mercury manometer. 5-10 determinations were made on each patient throughout the anesthetic to give a total of 210 pairs of measurements. All pressures were determined while the patient was in the supine position. Correlation coefficients and linear regressions were calculated for the systolic, diastolic, and mean pressures at each of the 5 sites as compared with those obtained simultaneously from the proximal right arm. The mean pressure difference was calculated by the following formula: Σ(non-standard cuff site pressure minus right arm cuff site pressure)/number of determinations.

Results: The slopes, intercepts, and correlation coefficients produced by the linear regression analysis are presented in Table 1. Figure 1 shows the mean pressure differences (±S.D.) for systolic, mean, and diastolic pressures at each of the five non-standard cuff sites.

Discussion: In the operating and recovery rooms, it is frequently desirable to noninvasively monitor arterial blood pressure using cuffs placed at sites other than the proximal arm. However, the relationship between pressures obtained at these sites as compared with those obtained in the usual fashion is not well known. Work involving the monitoring of arterial waveforms during pull-back of catheters from the proximal aorta to peripheral arteries would suggest that systolic pressures should increase as BP cuffs were placed more distally. This phenomena is evidenced in the present study by the elevated systolic pressures observed at the forearm, thigh, and calf sites (mean difference = +5.47 mmHg, +6.72 mmHg, and +18.82 mmHg respectively) as compared with systolic pressures measured simultaneously in the right arm. The decreased systolic pressure at the finger site may have been due to peripheral vasoconstriction as no special attempt was made to keep the hands and digits warm. Mean pressures as monitored at the forearm and thigh showed the highest degrees of correlation with pressures obtained simultaneously from the right arm. Furthermore, the mean differences and standard deviations associated with these values are within the guidelines proposed by the Association for the Advancement of Medical Instrumentation which state that intrapatient error should be less than 5 mmHg with a standard deviation of less than 8 mmHg.(1) Should it be necessary to monitor arterial blood pressure using the oscillometric technique at a non-standard location, this study would suggest that the cuff be placed around either the forearm or the thigh and that mean pressure would be the parameter to observe. Other sites may be utilized with the knowledge that the pressures obtained may not as closely reflect those which would have been seen from a cuff on the proximal arm.

	Slope	Y Intercept	r
Systolic			
L Arm	0.804	24.36	0.926
Forearm	0.994	6.14	0.919
Thigh	1.127	-8.76	0.926
Calf	1.372	-25.32	0.785
Finger	0.757	19.00	0.773
Diastolic			
L Arm	0.838	14.21	0.889
Forearm	0.878	7.63	0.926
Thigh	0.874	1.39	0.874
Calf	1.073	-7.41	0.832
Finger	0.819	13.84	0.734
Mean			
L Arm	0.843	17.36	0.908
Forearm	0.956	4.80	0.936
Thigh	1.034	-7.69	0.939
Calf	1.121	-6.89	0.807
Finger	0.918	2.57	0.767

Table 1. Slopes, intercepts, and correlation coefficients for systolic, mean, and diastolic pressures at non-standard cuff sites.

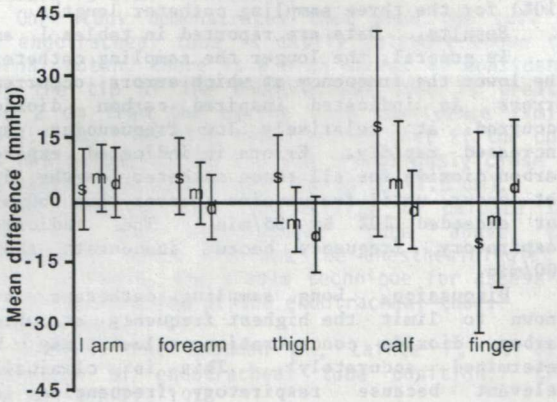

Figure 1. Mean differences ± S.D. in mmHg for systolic (s), mean (m), and diastolic (d) pressures at non-standard cuff sites.

Reference: 1. Standard for electronic or automated sphygmomanometers (proposed) October 1985 revision. Association for the Advancement of Medical Instrumentation Arlington VA p 39-40.