

Comparison of arm and calf blood pressure

INTRODUCTION

It is a standard practice to measure non-invasive blood pressure (NIBP) in the perioperative setting using oscillotonometric equipment.

In our study, blood pressure (BP) was measured in the arm and calf preoperatively with an aim to determine whether there was any correlation between the two. This was done so that the surgeries in which upper arm could not be used for measurement of BP intraoperatively, the calf could be used as an alternative site. For instance, in patients undergoing mastectomy, one arm is available for intravenous (i.v) cannulation and NIBP measurement, which leads to repeated

occlusion of the i.v. line. In patients with polytrauma, amputated arm, burns and multiple i.v. lines, as in patients with shock, neither arm is available for BP monitoring.

METHODS

This study was undertaken after approval from the institutional review board over a period of 3 months in 2010. Two hundred and fifty ASA grade I-III patients who had to be operated under anaesthesia were taken as subjects for our study. Patients in the age group of 20-64 years were included in the study.

Patients with hypertension with BP above 160/110 mmHg, pregnancy, obesity and skin infection over the arm or calf that would prevent measurement were excluded from the study.

The procedure was as follows:

After the patient was shifted to the operation theatre (OT), the patient was made to relax for 5 min. The systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured at each of the two sites – arm and calf – in a predetermined random order on the right side in the supine position before induction. Two baseline readings were taken and an average of the two was taken as the reading. Before BP measurement, no painful stimulus or any drug was given. A single BP instrument was used to avoid instrument error. In half of the patients, BP was taken in the arm first and in the other half, BP was taken in the calf first to avoid the effect of patient anxiety. A standard adult-sized appropriate cuff was used, the bladder of the cuff being at least 40% of the circumference of the limb being measured. The same cuff was used to measure BP in both the limbs. According to the standard guidelines, the middle of the bladder was placed over the artery being measured. For measurement of BP in the upper arm, the standard position was made with the arm resting on the OT table at the level of the heart. For the calf, the cuff was placed over the most prominent aspect of the posterior calf (where one would anticipate the popliteal artery to be).

Statistical analysis

Prior consultation with the medical statisticians had given a power calculation of 175 subjects required to achieve statistical significance, and thus we decided to include 250 subjects in our study. “At 0.05 type I error-alpha and 0.20 type 2 error-beta, Hypothesizing

difference of 3 in mean blood pressure (MBP) in arm and leg group patient, along with hypothesizing SD of 10 in both groups, sample size calculated was 175 patients.”

RESULTS

Results were analysed comparing SBP and DBP at each of the two sites in 250 patients using the Bland Altman approach. The limits of agreement were calculated by evaluating the difference between each pair of scores [Table 1].

As shown in Table 2, the mean SBP in the arm was 127.72±15.65 mmHg and in the leg was 142.97±22.18 mmHg. The mean DBP in the arm was 80.67±11.12 mmHg and in the leg was 75.66±11.89 mmHg. The MBP in the arm was 96.34±11.71 mmHg and in the leg was 98.24±13.94 mmHg. With respect to the SBP values, for an individual, the calf measurement is on an average 15.25 mmHg higher than the arm measurement. It ranged from 25 mmHg more in the arm as compared with the leg and 80 mmHg more in the leg than in the arm. The mean DBP of the upper limb was 5 mmHg more than in the lower limb. It ranged from 30 mmHg more in the arm as compared with the leg and 26 mmHg more in the leg than in the arm. The MBP was on an average 2 mmHg (95% limits of agreement 18.69–22.47), higher than the arm.

DISCUSSION

A number of previous studies have looked at alternative sites for measurement of NIBP. Overall, SBP measurements were higher in the calf than in the

Table 1: Limits of agreement for SBP, DBP and MBP (mmHg)

	Mean difference	95% limits of agreement
Systolic BP leg-arm	15.25	17.86 to 48.34
Diastolic BP leg-arm	-5.01	-25.44 to 15.44
Mean BP leg-arm	1.89	18.69 to 22.47

BP - Blood pressure, SBP - Systolic blood pressure, DBP - Diastolic blood pressure, MBP - Mean blood pressure

Table 2: Minimum, maximum, mean and standard deviation of SBP, DBP and MBP in the arm and leg

	Arm		Leg		MBP	
	SBP	DBP	SBP	DBP	Arm	Leg
Minimum	95	48	93	44	66.00	65.00
Maximum	160	109	233	114	125.00	144.00
Mean	127.72	80.67	142.97	75.66	96.34	98.24
Std. deviation	15.65	11.12	22.18	11.89	11.71	13.94

SBP - Systolic blood pressure, DBP - Diastolic blood pressure, MBP - Mean blood pressure

arm in patients undergoing surgery, colonoscopy and caesarean delivery under spinal anaesthesia.^[1-3]

Differences in MBP and DBP were not consistent. Large differences for some individuals make it difficult to devise a predictive formula that would be applicable in all situations.^[2]

Zahn *et al.* in a study showed poor correlation between BP on the calf and arm in parturients undergoing caesarian section.^[3] However, it is confounded by the fact that the gravid uterus leads to spurious BP readings in the lower limb.

Moore *et al.* in a study comparing BP in the arm, calf and ankle concluded that there was a poor agreement between the different sites with respect to SBP: The agreement was closer for DBP and MBP measurements. The MBP calf measurement was on average 4 mmHg (95% limits of agreement -12 to 20), higher than the arm. The ankle was 8 mmHg higher (-8 to 24) than the arm.^[4] Moore *et al.* in their study used the same sized cuff for measurement of arm and calf BP, whereas a standard or small sized cuff was used for ankle BP measurement. Similarly, in our study, we used the same cuff to measure BP in the calf and upper arm as their diameter is similar.

CONCLUSION

There was a poor agreement between the different sites with respect to SBP and DBP, and the agreement was closer for MBP measurements. The calf can be used as an alternative site for measurement of BP where the midarm cannot be used.

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