

## WRIST BLOOD PRESSURE- CAN IT BE AN ACCEPTABLE METHOD OF MONITORING BLOOD PRESSURE IN PERIOPERATIVE SETUP

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### ABSTRACT

**Introduction-** Blood pressure measurements are internationally recognized as essential parameter for monitoring change in health & illness. The upper arm (UA) is primary site used to obtain blood pressure measurement during anaesthesia. However when it is not possible to use the UA, the forearm (FA) is commonly used as alternative site.

**Material & Method-** A prospective, observational study was conducted. Sixty five patients of either sex, age between 15-60 years and American society of anaesthesiology (ASA) physical status class I or II were enrolled. Patients were placed in supine position with arm at the level of heart for each measurement. Each subject had sequential determination of UA and FA noninvasive blood pressure (NIBP) with automated monitor. Two readings were taken each for UA and FA at a gap of two min each. Main outcome was correlation between UA and FA systolic BP (SBP) and diastolic BP (DBP).

**Results-** The mean FA & UA SBP were 130.60 and 123.19. The mean FA and UA DBP were 80.1 and 72.4. Pearson's correlation coefficient between FA and UA SBP was 0.891 and for DBP was 0.676. The average readings for the SBP and DBP were higher in FA than in UA by approximately 7 mm of Hg. Statistically significant difference existed in both SBPs and DBPs.

**Conclusion-** This study has shown that there is potential for use of FA BP measurement during anaesthesia. Blood pressure from FA is probably higher than it would be from upper arm. But dynamic changes in BP rather than absolute value are important to determine treatment of significant BP changes under anaesthesia.

### INTRODUCTION

Blood pressure measurements (BPM) are internationally recognized as essential parameter for monitoring change in health and illness [1]. Blood pressure measurement was first used during anaesthesia by Cushing in 1901[2]. Now it is part of the minimum standard of patient monitoring and should be measured in all patients undergoing general anaesthesia, regional anaesthesia and sedation. In combination with other monitoring, it will help detect 93% of adverse events occurring under anaesthesia[3].

The upper arm (UA) is primary site used to obtain blood pressure measurement and during anaesthesia UA noninvasive BPM (NIBP) is most commonly accepted method of BP monitoring. However when it is not possible to use the UA, the forearm (FA) is commonly used as alternative site [5]. Under certain circumstances we have to use FA for BP measurement. For example, Only one arm or FA available for both fixing IV line and BP measurement like in a case of injury on other arm or both upper arms or surgery on one of the upper limb or surgeries like radical mastectomy. Sometime inflation of cuff causes backflow of blood into the IV line and partial or complete blockage of IV line in the case BP measurement done on upper arm. Also in obese individual use of normal size cuff on arm will yield inaccurate

readings, some practitioner obtain FA BP when large size cuffs are not available [7].

Healthcare providers are increasingly obtaining BP in FA in place of UA but clear parameters are not known for BP taken in this location. To determine whether these FA readings are accurate, we performed a prospective observational study in a sample of perioperative patients in operating room to compare the BP measurement in UA & FA.

### METHOD

In this study 65 patients of either sex, age between 15-60 years belonging to American Society of Anaesthesiology (ASA) physical status class I or II were enrolled. An informed consent was obtained from the patients. Patients were placed in supine position on bed to put arm at the level of heart for each measurement. Each subject had sequential determination of UA & FA NIBPs with automated monitor (PHILLIPS INTELLIVUE MP50). Two readings were taken each for UA & FA (near the wrist) at a gap of two min each.

The main outcome measure was correlation between UA & FA systolic BP (SBP) and diastolic BP (DBP). Pearson's correlation coefficient and student t test were used to analyze the data.

### Demographic Profile

Table 1: It shows the demographic profile (no. of patients according to sex and age) of patients included in the study

Sex	No. of Patient	Percentage	Age mean(range)
Male	45	69.23	34.5(15-58) yrs.
Female	20	30.77	35.1(15-60) yrs.

### Statistical Analysis

Table 2: It shows mean of various readings of SYSTOLIC BP of upper arm and fore arm in all subjects included in study, their standard deviation and range

Systolic BP	Mean	Standard Deviation (S.D.)	Range
Upper arm	123.19	16.20	91-155
Forearm	130.60	19.32	92-165

- Pearson's correlation coefficient between FA and UA SBPs was 0.891
- Paired t Test revealed significant difference between FA and UA SBPs ( $p < 0.0001$ )

**Table 3: It shows mean of various readings of DIASTOLIC BP of upper arm and fore arm in all subjects included in study, their standard deviation and range**

Diastolic BP	Mean	Standard Deviation (S.D.)	Range
UPPER ARM	72.48	13.86	45-99
FOREARM	80.10	12.95	55-105

- Pearson's correlation coefficient between FA & UA DBPs was 0.676.
- Paired t Test revealed significant difference between FA & UA DBPs

((p < 0.0001) S.D.)

## RESULTS

In our study 65 Patients were enrolled. The mean age of patients was 35.3 (15-60) years and 30% were females. Patient's characteristics are shown in table1. The mean FA and UA SBP were 130.60 and 123.19. The mean FA and UA DBP were 80.1 and 72.4. Pearson's correlation coefficient between FA and UA SBP was 0.891 and for DBP was 0.676. The average readings for the SBP and DBP were higher in FA than in UA by approximately 7 mm of Hg. Statistically significant difference existed in both SBP and DBP.

## DISCUSSION

Blood pressure measurement is a major indicator of patient's health status regardless of age, race and gender[1]. Conventionally upper arm is used to obtain BP measurement but in circumstances where BP measurement in upper arm is not possible, forearm is used as an alternative site to measure BP. So we performed a prospective observational study in a sample of perioperative patients in operating room to compare the BP measurement in UA and FA.

The use of forearm blood pressures has recently gained attention in the literature. Our study findings support the research done in past. Both SBP and DBP measurements were significantly higher in FA than in UA.

A Study by Emrick et al in 2002 states that wrist BP consistently overestimate mean arterial, systolic and diastolic BP by approximately 10 mm of Hg. SBP difference was 11.2 and DBP difference was 10.2. Mean BP difference was 10.6 mm of Hg[1]. Another study by Singer et al, compared FA and UA noninvasive BPs in 151 seated stable patients (mean age 35 ± 16.7 years) in an ambulatory emergency department. The correlation between forearm and upper arm systolic BPs was 0.75 and for diastolic BPs was 0.72 (P < 0.001). The differences between forearm and upper arm systolic and diastolic BPs was within 20 mm Hg in 86% and 94% of participants, respectively. The researchers reported that forearm BP was an acceptable predictor of the standard upper arm BP when measurement of upper arm BP was not possible[4]. Replicating Singer's study, Schell et al investigated differences in forearm and upper arm automatic noninvasive BPs in 204 seated, stable emergency department patients. Mean age of participants was 36.5 ± 16.5 years. A paired t-test revealed significant differences (t = 2.07, P = .04) between mean upper arm and forearm systolic BPs. A 14 to 20 mm Hg difference was found between systolic, diastolic, and mean forearm and upper arm BPs as determined by Bland-Altman analyses indicating clinically significant differences between forearm and upper arm measurements[5]. Pierin et al studied forearm BPs in the obese population. Using appropriate cuff sizes, the researchers obtained 3 UA and 3 FA oscillometric BPs, each 2 minutes apart, from 129 seated participants, mean age 45 ± 14 years, with mean body mass index (BMI) of 40 ± 7 kg/m<sup>2</sup>. Analysis of variance revealed that upper arm systolic and diastolic BPs were significantly lower (P < 0.05) than forearm BP and concluded that forearm BP measurements could inappropriately inflate the prevalence of hypertension diagnoses in the obese[6]. Although using the auscultatory method, Palatini and colleagues also compared wrist and upper arm BP readings in 85 supine participants (mean ge 47 ± 16 years). A pediatric cuff was used for wrist BPs while a standard cuff was used for the upper arm. The limb was placed at heart level for all readings. Six sequential ipsilateral BPs were obtained, alternating cuff sites. Auscultatory wrist BP measurement overestimated upper arm BP measurement

with systolic BP differences 8.2 ± 9.7 mm Hg and diastolic differences 9.2 ± 6.4 mm Hg[7].

Another clinical trial sponsored by university of British Columbia in Canada is going on for wrist NIBP measurement during elective caesarian section. During anaesthesia it may be challenging to obtain an accurate measurement from automated device in over 50% of attempts as patient may voluntarily move their arm or it may be due to shivering induced by neuraxial anaesthesia. To eliminate the effect of movement of upper arm NIBP tested on leg because it is immobilize during neuraxial anaesthesia. However, studies monitoring BP on an ankle or a calf were unable to accurately detect changes in BP in patients undergoing cesarean delivery. It is also reasonable that in the case of a shivering patient, the FA with less muscle mass would shake less and could be stabilized more easily than the UA. Positioning NIBP cuff on FA (near wrist) may be useful to obtain accurate BP measurement in the patient undergoing caesarian section under SAB[8].

With the device used and within the normal BP range compensation can be performed by subtracting 10 mm of Hg from measured value or simply by elevating the wrist above 15 cm and taking the BP at face level. Wrist NIBP may be viable clinical alternative in situations where difficulty occurs with upper arm NIBP measurement.

## CONCLUSION

FA is an acceptable method of BP monitoring in case UA is not available for the same. The pressure from FA is probably higher than it would be from upper arm. But dynamic changes in BP rather than absolute value are important to determine treatment of significant BP changes under anaesthesia. This study has shown that there is potential for use of FA BP measurement during anaesthesia. Further studies enrolling larger number of patients and BP measurement done during entire perioperative period will be required to establish this as a standard technique of BP measurement.

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