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Original Research Article

Measurement of Diastolic Blood Pressure Without Stethoscope...Is It Possible?

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Abstract: There are different methods of measuring blood pressure. Palpatory method is one of the most commonly used methods of measuring blood pressure. But one measures only systolic BP using this method. Measurement of diastolic blood pressure is mentioned in literature though not used commonly. Hence we decided to assess whether palpatory method is accurate for measuring diastolic blood pressure as compared to auscultatory method of measurement of BP. We have included 200 patients in our study. Systolic and diastolic blood pressures was measured first by palpatory method by one of the investigators. Then it was measured by auscultatory method by an investigator who was blinded to the previously measured value. We found that DBP recordings matched exactly in 153 patients, and were accurate in 27 patients, acceptable in 11 and unacceptable in 2 patients. We couldn't measure diastolic BP in 7 patients Palpatory method may be useful while measuring BP in noisy environment where hearing Korotkoff sounds may be difficult, like in mass disaster.

Keywords: Auscultatory method, Diastolic blood pressure, Palpatory method

INTRODUCTION

Blood pressure measurement is an important part of physical examination in assessment of patient as it gives an idea of baseline cardiovascular status. With each heartbeat, blood is pumped out into arteries and throughout the body. Pressure exerted by the blood pushing against the walls of the arteries is measured as blood pressure. Adequacy of circulation can be assessed by measuring BP; therefore, cardiovascular examination is incomplete without measurement of systolic and diastolic BP. Commonly, auscultatory or palpatory method is used for measurement. Palpatory method is very easy, quick and requires only sphygmomanometer. But traditionally only systolic BP can be measured by this method. Diastolic BP is an important part of blood pressure. During mass casualty, stethoscope may not be available or it may be difficult to hear sounds with stethoscope due to noisy surrounding. Hence if we can measure diastolic BP by palpatory method, it would be very useful. Palpatory method of measuring diastolic BP is mentioned in literature [1]. Hence we decided to assess whether the readings by this method of assessment of diastolic BP are comparable to auscultatory method.

MATERIAL& METHOD

This cross-sectional study was carried out in the anaesthesia OPD of a teaching hospital and included 200 preoperative patients. Two independent observers estimated the BP of each patient. One observer measured the BP of the patient using the palpatory method described below. Keeping the cuff of the sphygmomanometer in place, the other observer measured the BP of the patient by the auscultatory method immediately with the patient in the same pose. Same investigator took palpatory BP readings in all the patients. Before starting the study, preliminary readings were taken to accustom the investigator to the palpatory method.

Patients were arranged to seat with legs uncrossed and back and arm supported at the heart level with palm upwards. All clothing covering the cuff location was removed and arm was exposed five inches above the elbow, restrictive clothing, if any, was also removed from the arm. For BP measurement, patients were seated for five minutes before the reading. We ensured use of proper size cuff. Centre of rubber bladder of cuff is placed over brachial artery and cuff is wrapped firmly and smoothly around the arm, one inch above the antecubital space.

Method of measuring Diastolic Blood Pressure using Palpatory Method [1]:

1. Radial pulse was palpated using index finger, middle finger and ring finger of non-dominant hand
2. The cuff was inflated to about 30 mmHg above the pressure at which the pulse disappeared.
3. Index, middle and ring fingers of non-dominant hand were placed lightly over the bend of the elbow at medial side of antecubital fossa, so that palmar surface of tips of these fingers made firm contact with antecubital fossa without trying to feel pulse of brachial artery.
4. The cuff was deflated slowly (approximately 2mmHg/sec).

While deflating the cuff a pulsatile thrill can be palpated, the pressure at which thrill appeared was taken as systolic pressure and, the disappearance of the thrill was Diastolic Blood Pressure.

The auscultatory Method to Measure Diastolic Blood Pressure:

The cuff was inflated to about 30 mmHg above the pressure at which the pulse disappeared. Cuff was gradually deflated (2mm Hg/sec), simultaneously auscultating the sounds produced by arterial pulse waves. Pressure at which Korotkoff sounds first appear, was noted as systolic pressure and pressure at which sounds disappeared was noted as diastolic blood pressure [2].

These two BP readings were compared. When readings of palpatory and auscultatory method agree within 20mmHg for systolic or within 10 mm Hg for diastolic, the palpatory method is regarded as acceptable. When readings of palpatory and auscultatory method agree within 10 mmHg for systolic or 5 mm Hg for diastolic, the palpatory method is regarded as accurate. When disagreement is 20 or larger than 20 mm Hg for systolic or 10 or more than 10 mm Hg for diastolic, the palpatory method is regarded as unacceptable.

RESULTS

The age range is 15 years to70 years (Table 1), with 91males and 109 females (Table 2). Pulse rate ranges from 50 to100 (Table 3). The range of systolic BP by auscultatory method is 86 to 150mm Hg and diastolic BP is 56 to 98 mm Hg. In 102 patients, systolic BP readings agreed in toto. In 95 patients, systolic BP readings were accurate, three were acceptable and none were unacceptable. In 153 patients, diastolic BP readings agreed in toto. In 27 patients, diastolic BP readings were accurate, 11 were acceptable and two were unacceptable. In 7 patients diastolic BP could not be measured as palpable thrill continued till mercury dropped to zero (Table 4). Interrater agreement between measurement by auscultatory and palpatory method is given in (Table 5).

Table 1: Table showing distribution of patients in relation to age

Age group	Number	Percentage
15-25	30	15
25-35	42	21
35-45	37	18.5
45-55	41	20.5
55-65	22	11
>65	28	14

Mean +/- S D= 42.43+/- 16.60

Table 2: Table showing distribution of patients in relation to sex

Gender	Number	Percentage
Males	92	46
Females	108	54

Table 3: Table showing average heart rate and weight

Parameter	Mean	S D
Heart rate	76.82	12.88
Weight	52.09	9.49

Table 4: Table showing distribution of patients in relation to difference in BP measurement by palpatory and auscultatory method

	Systolic BP				Diastolic BP				
Difference (mm Hg)	>=20	10-19	0-10	0	>=10	5-9	<5	0	Couldn't be measured
No. of patients	0	3	97	102	2	11	27	153	7

Table 5: Interrater agreement between measurement by auscultatory and palpatory method

Inter rater agreement	SBP	DBP
Infraclass coefficient	0.951	0.566
P value	0.000	0.000
Interpretation	Excellent	Moderate

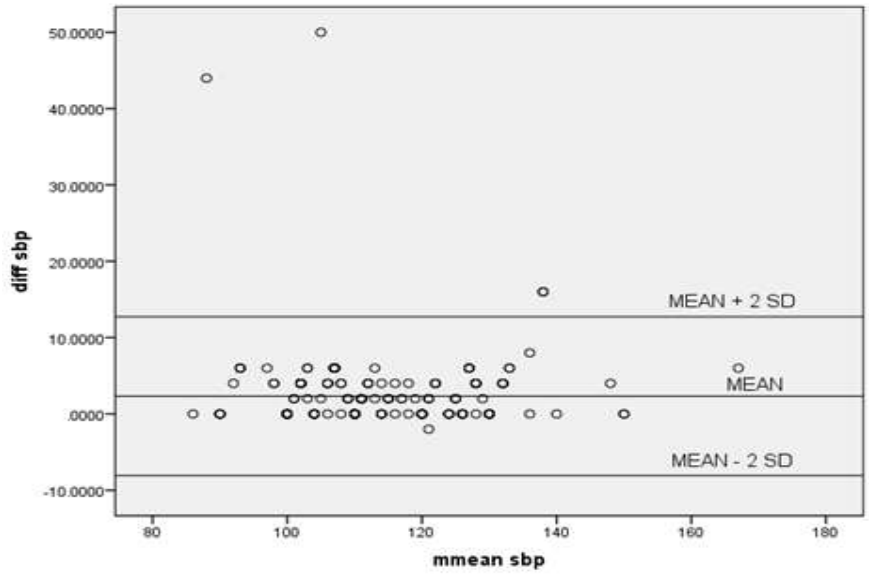

Fig 1: Bland Altmann analysis of overall SBP between palpatory and auscultatory method

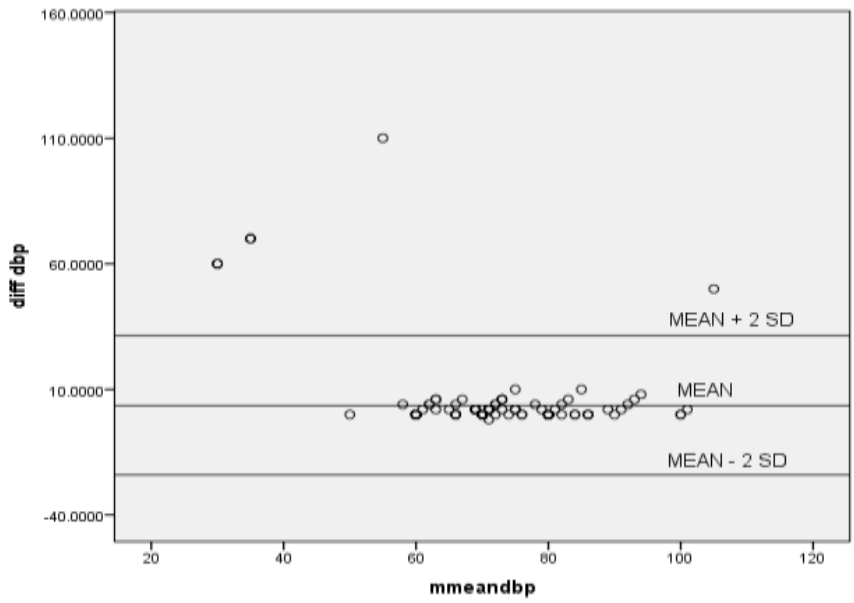

Fig 2: Bland Altmann analysis of overall DBP between palpatory and auscultatory method

Figure-1 shows the Bland Altmann analysis of the mean values and the difference values between the auscultatory method and palpatory method. Middle line is the mean difference value (2.33 mmHg). Upper and Lower lines are the lines of agreement. Most of values lie between these lines of agreement which indicates that the palpatory method has good agreement with the auscultatory method. The range of difference between the two is -8.07 mmHg on lower side and 12.73 mmHg on upper side. This range is acceptable with an Intra Class Coefficient of 0.951, which even indicates excellent Inter Rater agreement.

Figure-2 shows the Bland Altmann analysis of the mean values and the difference values between the auscultatory method and palpatory method. Middle line is the mean difference value (3.66mmHg). Upper and Lower lines are the lines of agreement. Most of values lie between these lines of agreement which indicates that the palpatory method has good agreement with the auscultatory method. The range of difference between the two is -24.08mmHg on lower side and 31.4 mmHg on upper side. Intra Class Coefficient is 0.566, which even indicates moderate Inter Rater agreement.

DISCUSSION

There are direct and indirect methods of measurement of BP. Direct intra-arterial measurement is the gold standard for measurement of arterial blood pressure but is an invasive and costly method. Direct method measures pressure, while the indirect methods are more indicative of flow [1]. Hence measurement by these methods is similar but not identical. Indirect methods are less accurate but sufficiently accurate. The indirect methods of measurement being non-invasive, easy to use, widely available and low in cost are used more commonly.

Indirect methods include palpatory and auscultatory method. Both these methods require only a sphygmomanometer and the auscultatory method requires additionally a stethoscope for the pressure measurement. Palpatory method is commonly used to measure systolic blood pressure and the auscultatory method to measure systolic as well as diastolic blood pressure. We asked the patients to seat comfortably for five minutes before taking the reading. All clothing covering the cuff location was removed. We ensured that rolled-up sleeves did not form tight band which may act like a tourniquet. While taking readings, patient were asked to seat comfortably, with back supported, legs uncrossed. An unsupported back may increase diastolic pressure; crossing the legs may increase systolic pressure. Patient's arm was supported at heart level i.e.at the midpoint of the sternum. Position of the upper arm below the level of the right atrium may overestimate BP readings; and position of the upper arm is above heart level may underestimate the readings. If the arm is kept unsupported and held up by the patient, pressure can be higher.

The most common error in the measurement of blood pressure is choosing wrong size cuff [3]. Hence we ensured a proper size of BP cuff in all the patients. We followed recommendation of American Heart Association (AHA), which states that the bladder width should be at least 40% of the circumference of the extremity and bladder length should be sufficient to encircle at least 80% of the extremity. Too narrow cuff may require excessive inflation pressure to occlude brachial artery, and systolic BP readings may be as much as 50 mm Hg high (usually 10 mm Hg high.) and diastolic BP reading 5 mm Hg high. Overly large cuff in adults rarely underestimates the BP by more than 5 mm Hg systolic and diastolic.

Blood pressure opposes the constriction of the artery by cuff pressure. Therefore, the cuff pressure must be greater than the highest blood pressure, the systolic pressure. In order to completely constrict the artery. Initial compression may cause spasm of the artery. Patient may be anxious and apprehensive on feeling of the discomfort of pressure. Slow initial deflation allows both spasm and anxiety to disappear at the time the blood flows under the cuff. The rate of deflation in indirect blood pressure measurement significantly impacts the reading. AHA recommends that the cuff be inflated to at least 30 mm Hg above the point at which the radial pulse disappears. The cuff should then be deflated at a rate of 2 to 3 mm Hg per second (or per pulse when the heart rate is slow).Deflation rates greater than 2 mm Hg per second may underestimate systolic pressure and overestimate diastolic pressure. Hence we decreased the cuff pressure gradually at the rate of 2 mm Hg per second.

When cuff pressure decreases below the systolic blood pressure, blood can pass through the constricted opening of the artery and hence pulse can be palpated. Hence, the point at which the cuff pressure is first overcome is taken as systolic pressure. Taking next BP readings within 1 minute may cause venous congestion. Leaving the cuff partially inflated for too long will fill the venous system and make the sounds difficult to hear. Hence reading by auscultatory method was taken 1 minute after taking reading by palpatory method.

Auscultation of Korotkoff sounds permits estimation of both systolic and diastolic blood pressures. Korotkoff sound results from turbulent flow within an artery created by the mechanical deformation from the blood pressure cuff. The appearance of the first Korotkoff sound is the maximum pressure generated during each cardiac cycle: the systolic pressure. The level of pressure at which the sounds

disappear permanently, when the artery is no longer compressed and blood flow is completely restored, is the resting pressure between cardiac contractions: the diastolic pressure. "As the pressure is reduced during deflation of the occluding cuff, the Korotkoff sounds change in quality and intensity [4]. The sharp (phase 4) Korotkoff sounds can be palpated by a thumb kept lightly over the brachial artery. Felt as sharp knocks, the "sounds" appear a little before the diastolic reading, increase slightly in their sharpness, and suddenly disappear; then the normal brachial pulse can be felt.

Use of auscultatory method requires hand/ eye/ ear coordination, as we have to hear and differentiate the Korotkoff sounds and see the movement of mercury column at the same time releasing the valve of sphygmomanometer. For palpatory method, only hand/eye coordination is needed as we palpate the thrill while deflating the cuff of sphygmomanometer. Palpatory method uses the sense of touch; Auscultatory method uses the sense of hearing. Jules constant [6] has described a palpatory method to measure diastolic pressure. He described that with the thumb on the brachial artery, just under the distal edge of the cuff, one can palpate the systolic pressure as the cuff is deflated and the pulse returns. As the cuff is further deflated towards diastole, the brachial pulse becomes increasingly more slapping and hyper dynamic, until it suddenly changes to a more normal rate of rise. This point of change correlates well with the diastolic pressure at about time of muffling. He stated that Diastolic BP is difficult to appreciate in radial pulse.

We found no relation of age, sex, weight or heart rate on accuracy of measurement of diastolic BP by palpatory method. Our findings correlated to those of Vaidya et al.; [7] who also found that irrespective of age, sex or diastolic BP, the recording by palpation was accurate. We found that DBP recordings matched exactly in 153 patients, and were accurate in 27 patients, acceptable in 11 and unacceptable in 2 patients. Sahu et al analysed auscultatory and palpatory method and found that 51 % patients had systolic and diastolic blood pressure measured by palpatory method, within + 2 mmHg of auscultatory method, 20 % patients had within + 4 mmHg, 25 % patients had same readings as with auscultatory method. We couldn't measure diastolic BP in 7 (0.035%) patients. Sahu and Bhaskaran [1] could not be measure diastolic BP with palpatory method in 0.5 % patients.

Sahu and Bhaskaran found that the palpatory method can't be used in shivering, tremor, severe obesity, moderate to severe hypotension and heart disease. Shivering and tremor causes mechanical interference in measurement. In severe obese patients, thick subcutaneous fat probably prevents thrill to transmit to surface. Elderly patients have very thin subcutaneous fat, which leads to continuous palpation of pulse throughout measurement, making it difficult to identify thrill in pulse [1]. We couldn't measure diastolic BP in 7 (0.035%) patients, out of which 3 patients were above 60 years of age. None were obese, hypertensive or with heart disease. No patient had shivering or tremors. But the major difference was that we studied patients preoperatively and Sahu and Bhaskaran [1] studied mixed population of patients during exercise in treadmill, preanaesthetic checkup and intraoperative period.

Palpatory method would be very useful where blood pressure measurement is required but we may not be able to hear Korotkoff sounds due to noises around, and stethoscope may not be available, as in a mass casualty. It may be useful in wards, busy OPDs and also whenever stethoscope is not available. Though NIBP is being used widely, tremors or shivering can delay cuff deflation and prolong deflation cycle. A compartment syndrome attributed to prolonged inflation cycle has been reported [5]. NIBP is not available widely in third world countries; also it may not be available and practical in mass casualty. Hence while newer methods of measuring BP are being introduced, let us not forget sensitivity of human finger. We accept the limited number of patients as a limitation of our study; further studies need to be done to confirm the accuracy. With practice, we may be able to improve accuracy; further studies are needed in this regard as well. We feel that there appears to be a place for palpatory method of estimation of Diastolic BP especially in disasters and mass casualties.

CONCLUSION

Palpatory method is worth learning as error margin is not excessive and the method is simple and quick. It may be of use in mass casualties when stethoscope is not available or when we may not be able to hear due to noises around.

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