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ORIGINAL RESEARCH

Validation of measurement of systolic blood pressure; by pulse oximetry with conventional methods in general population, peripheral vascular disease patients

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ABSTRACT

Introduction: Blood pressure is the lateral pressure exerted by circulating blood against the walls of the blood. Blood pressure can be measures using different methods, however, the gold standard being the Auscultatory method.(1) Pulse oximeter is a device used for monitoring pulse rate and saturation.(2) Peripheral vascular disease (PVD) is a key reason for mortality and morbidity(3).It is usually diagnosed with Anke Brachial Index(ABI) by Doppler but is expensive and not easily available. Pulse oximetry was the method used to record the blood pressure of the patients in the present study. Hence the present study was done to study the validity of Pulse oximetry wave pattern appearance in the measurement of systolic blood pressure by comparing it with Auscultatory (conventional) method of blood pressure recording in individuals.2. To study the validity of systolic blood pressure for Ankle Brachial Index using pulse oximetry waveform pattern appearance by comparing it with Doppler (conventional) method in Peripheral Vascular Diseases.3. To measure systolic blood pressure using pulse oximetry in Takayasu Arteritis cases. **Methodology:** A cross- sectional analytical study was conducted in Kasturba Medical College, Mangalore from September 2019 to September 2021 among patients attending general OPD and Peripheral Vascular Disease population and Takayasu Arteritis cases. **Results:**183 individuals in General population met the inclusion criteria and systolic blood pressure measured using auscultatory and pulse oximetry method was compared and results showed statistical significance between both the methods with p value < 0.05 and Intraclass Correlation Coefficient > 0.9. ABI measured in 60 PVD population using Doppler and pulse oximetry method when compared also showed statistical significance. 4 Takayasu Arteritis cases showed higher BP recordings when measured using pulse oximetry as compared to Doppler method. **Conclusion:** Through this study we conclude that Pulseoximetry reappearance of waveform method is accurate and feasible to measure the Systolic Blood Pressure. Pulse oximetry can also be used in Peripheral Vascular Disease patients, where Doppler might not be easily available. We also conclude that, Pulse Oximetry method of BP measurement can be used in Takayasu Arteritis cases, where SBP can be measured even when conventional methods fail to record Blood Pressure.

Key words: Systolic Blood Pressure (SBP), Pulse oximetry, Doppler method, Peripheral Vascular Disease, General population, auscultatory method

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INTRODUCTION

Blood pressure is the lateral pressure exerted by circulating blood against the walls of the blood vessels. The systolic blood pressure is the maximum pressure during the contraction of the heart. The diastolic blood pressure is the minimum pressure at the end of ventricular diastole. Blood pressure can be measures using different methods, however, the gold standard being the Auscultatory method. The other methods being Palpatory method, Oscillatory, Doppler method etc.(1)

Pulse oximeter is a device used for monitoring pulse rate and saturation. Earlier was confined only to emergency units and operating rooms(4). Currently, with easy accessibility, price and ease of application, it is routinely being used. Pulse oximeter works on the principle of photo plethysmograph where absorption of oxyhemoglobin and deoxyhemoglobin at red and infrared wavelengths differ(5). Oxyhemoglobin absorbs more at infrared wavelength more than at red wavelength when compared to deoxyhemoglobin. The pulse oximeter uses light at two different wavelengths (660 & 940) from two light emitting diodes. This light passes through the tissues, gets absorbed and detects oxygen saturation and heart rate(4)

Pulse oximeter is a newer method used in the measurement of systolic blood pressure done by monitoring the reappearance of pulse wave pattern on deflation of the sphygmomanometer(2). This method has previously been tried years ago in pediatric age group, in post-operative settings and on study in general population with no follow up studies.

Peripheral vascular disease is a key reason for mortality and morbidity. It is clinical condition in which there is narrowing in aorta or arteries in the limb due to atherosclerotic plaque(3). It is usually diagnosed with Ankle Brachial Index. Pulse oximetry method with pule wave pattern reappearance on deflation of sphygmomanometer method can be used instead of Doppler technique is our proposition through our study as Doppler may not be easily available and expensive compared to pulse oximeter.

Takayasu arteritis, otherwise called pulseless disease is a chronic inflammatory condition which usually affect the large arteries, mainly the aorta and its branches(6). In this condition, blood pressure is usually not recordable or on the lower side when recorded by conventional method even though they have hypertension and the actual BP recordings cannot be measured. Pulse oximetry method of BP recording was used in these patients.

MATERIALS AND METHODS

The present study was a Cross-sectionalcomparative study conducted over a period of twoyears at Kasturba Medical College, Mangalore, Karnataka. Patients visiting General OPD, patients with Peripheral Vascular Disease visiting hospitals and with Takayasu Arteritis in hospitals affiliated to KMC Mangalore meeting the inclusion and exclusion criteria were studied.

INCLUSION CRITERIA

Patients willing to give consent and above 18yrs,Patients who are hemodynamically stable visiting general OPDs of hospitals affiliated to KMC hospitals, Mangalore, PVD cases**,** Diagnosed Takayasu Arteritis cases**,** Patients where there is access to place the finger saturation probe were considered for the study.

EXCLUSION CRITERIA

Patients where it is difficult to get access for the probe placement, Patients in ICUs were excluded. Study was carried for a period of two years from September 2019 to September 2021**.**

SAMPLE SIZE

A total of 183 patients attending general OPD, 60 patients with Peripheral vascular disease and 3 patients with Takayasu Arteritisattending KMChospitalsduring the study period were the study participants.In the present study, finger saturation probe, calibrated aneroid sphygmomanometer and hand-held Doppler were used to measure SBP.Study was conducted in three groups i.e., patients attending General OPD, PVD cases and Takayasu arteritiscases.The SBP was measured when the volunteer was at rest and in sitting position and the two measurements were 2mins apart.In General, OPD patients, the SBP was first measured by Auscultatory method by placing an appropriate size cuff attached to sphygmomanometer and after 2 mins pulse oximeter method, by placing appropriate cuff attached to sphygmomanometer on one arm and finger saturation probe to the same arm, with visual display of pulse wave pattern, the cuff was inflated until the pulse wave disappears and then gradually deflated the cuff in 2mm Hg decrements until the pulse wave pattern reappears. This was recorded as SBP.Blood pressure was recorded in both the arms.

In Takayasu arteritis, SBP was first measured by Doppler method in all four limbs using a calibrated sphygmomanometer and a hand-held Doppler followed by Pulse oximeter wave form method with an aneroid sphygmomanometer.In Peripheral Vascular Disease cases, SBP of brachial artery and dorsalis pedis artery/posterior tibial artery was measured using calibrated aneroid sphygmomanometer and hand-held Doppler and then with calibrated aneroid sphygmomanometer and pulse oximeter wave form

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method. Then Ankle Brachial Index was calculated, both the sides.

DATA ANALYSIS

Data was entered and analysed by Statistical Package for Social Sciences (SPSS, version 25).Results were expressed using proportions and represented using tables.Correlation Coefficient was used across all three groups and $p<0.05$ considered statistically significant.

RESULTS

Among 183 patients attending the general OPD, SBP was measured using Pulse Oximetry method and Auscultatory (conventional) method for comparison.60 PVD patients were studied where ABI was calculated using Doppler method (conventional) and Pulse oximetry method and the values were compared for correlation. 4 Takayasu Arteritis patients were taken into the study and their SBP was measured using Doppler as well as Pulse Oximetry methods and analysed for correlation.

Table 1: Distribution of Study Participants:

STUDY GROUP	No of study participants(%)
GENERAL POPULATION	183(74.1%)
PERIPHERAL VASCULAR DISEASE	60(24.3%)
TAKAYASU ARTERITIS	4(1.6%)
TOTAL	247(100%)

GENERAL POPULATION

Age distribution

Among the 183General OPDpatients in the study, 9 were in between 18-20 years of age, 76 individuals between 20-40 years of age, 71 individuals between 41-60 years of age and 27 individuals between 61 to 80 years of age.

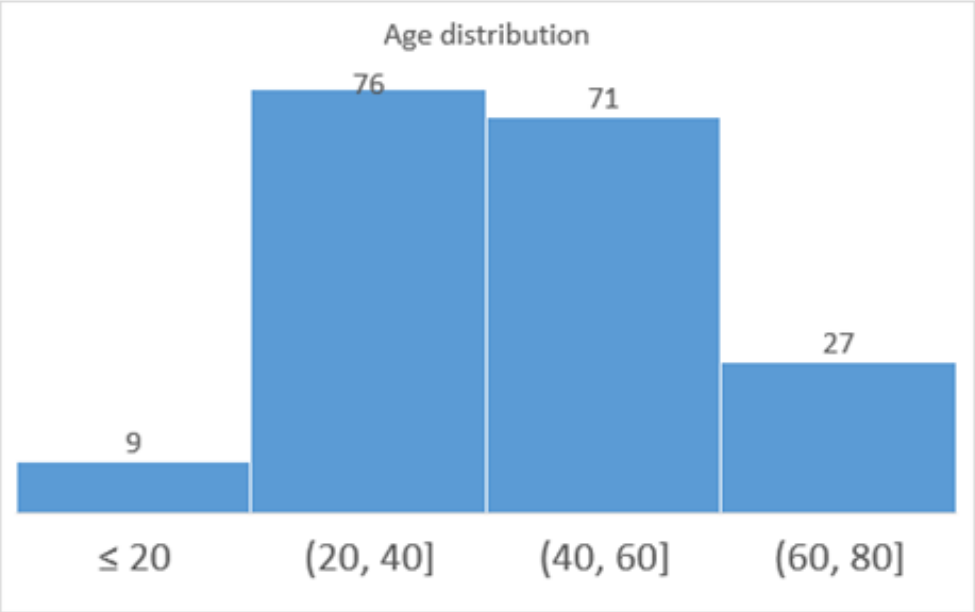

FIGURE 1: Age distribution among General OPD patients

GENDER DISTRIBUTION

Among the 183 General OPD patients that were included, 66 were female and 117 were males.

Among the 183 General OPD patients, 125 patients had no comorbidities, whereas 34 had Hypertension, 44 had Diabetes Mellitus, one person had Hypothyroidism and 3 had history of IHD.

Table 2: Distribution of general OPD patients based on comorbid condition

COMORBIDITIES	NUMBER	PERCENTAGE
HYPERTENSON	34	18.6
DIABETES	44	24
IHD	3	1.6
HYPOTHYROIDISM	1	0.5
NIL	125	68.3

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Table 3: Systolic Blood Pressure (SBP) MEASUREMENT AMONG GENERAL OPD PATIENTS

	MEAN	SD	p	ICC
RIGHT UL – CONVENTI ONAL	124.69	9.21	0.91 Not significant	0.998
RIGHT UL – PULSE OXIMETER	124.51	9.20		
LEFT UL – CONVENTI ONAL	124.75	9.31	0.85 Not significant	0.998
LEFT UL – PULSE OXIMETER	124.57	9.29		

The above table summarizes the data of 183 patients. In the right upper limb, using the conventional method, the mean of systolic BP was 124.69 with a standard deviation (SD) of 9.21. In Right upper limb (UL) with Pulse oximetry method, the mean SBP was 124.51 and SD of 9.20. The p value calculated using Paired t-test in between both the methods in Right Upper limbs was 0.91 which is NOT significant. However The Intraclass Correlation Coefficient (ICC) between the two methods in Right Upper Limb is 0.998 which is also considered statistically significant. In the left upper limb, using the conventional method, the mean of systolic BP was 124.75 with a standard deviation (SD) of 9.31. In left upper limb (UL) with Pulse oximetry method, the mean SBP was 124.57 and SD of 9.29. The p value calculated using Paired t-test in between both the methods in left Upper limbs was 0.005 which is highly significant. The Intraclass Correlation Coefficient (ICC) between the two methods in Left Upper Limb is 0.998 which is also considered statistically significant.

The above study in general OPD patients therefore proves that Pulse Oximetry method of SBP recording is validated when compared to the conventional (auscultatory) method, has accurate values and good correlation was obtained between the SBP by pulse wave pattern reappearance method and Auscultatory (conventional) method.

PERIPHERAL VASCULAR DISEASE POPULATION

AGE DISTRIBUTION

Among the 60 individuals with PVD that has been included in the study, 24 individuals were between 40 to 60 years of age, whereas 34 individuals were between 61 to 80 years of age
and 2 individuals above 80 years of age.

Among the 60 individuals that were included in the PVD population, the gender distribution is as follows with 15 females and 45 males, suggesting that majority of the study group were males.

Table 4: Distribution of patients based on Co-morbidities

COMORBIDITIES	NUMBER	PERCENTAGE
HYPERTENSION	25	41.7
DIABETES	52	86.7
IHD	19	31.7
CKD	2	4.2

Among the 60 PVD patients in the study, 25 had Hypertension, 52 had Diabetes Mellitus, 19 had history of IHD and 2 people had CKD. Based on this study, Diabetes and HTN are the major risk factors for PVD.

Table 5: SBP MEASUREMENT AMONG PVD PATIENTS

LIMBS	DOPPLER	%	PULSE OXIMETRY	%
RIGHT UPPER LIMB	60	100	60	100
LEFT UPPER LIMB	60	100	60	100
RIGHT LOWER LIMB	49	81	54	90
LEFT LOWER LIMB	51	85	54	90

While all upper limb recordings in all 60 individuals in the PVD study population were successful with both methods, the same was not true for lower limbs. In 36 limbs, systolic BP recordings of lower limbs could be measured with both the methods. In 15 limbs recordings were possible only with finger saturation method, where Doppler (conventional method) failed to get the systolic recordings. In 5 limbs, systolic BP recordings couldn't be measured by pulse oximetry method. In these 5 cases, conventional method i.e., Doppler method was successful. In four of the limbs, systolic BP couldn't be recorded with both the methods.

Table 6: STATISTICAL ANALYSIS OF PVD POPULATION DATA

	MEAN	SD	P	ICC
R UL – CONVENTIONAL	125.17	8.28	0.91	0.999
R UL – PULSE OXIMETER	125	8.24		

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R LL – CONVENTIONAL	117.25	20.91	1.00	0.999
R LL – PULSE OXIMETER	117.83	21.47		
R ABI – CONVENTIONAL	0.941	0.151	1.00	0.998
R ABI – PULSE OXIMETER	0.947	0.1578		
L UL – CONVENTIONAL	125.22	8.35	0.50	0.998
LUL – PULSE OXIMETER	124.95	8.16		
L LL – CONVENTIONAL	115.03	18.81	1.00	0.999
LLL – PULSE OXIMETER	115.53	18.64		
LABI – CONVENTIONAL	0.922	0.128	1.00	0.998
LABI – PULSE OXIMETER	0.928	0.128		

This table summarizes the statistical data analysis of the 60 individuals included under PVD study population. The RUL (Right Upper Limb) was first studied in all individuals, where the Systolic Blood Pressure (SBP) when measured by conventional (Doppler method) the mean SBP was 125.17 and Standard Deviation (SD) was 8.28, whereas the mean SBP with Pulse Oximetry method was 125 and SD 8.24.On analysis, for the Right Upper Limb Intraclass Correlation Coefficient (ICC) 0.999 which is highly significant was observed between these two methods.

The R LL(Right Lower Limb) was studied in 36 individuals as it was not possible in other individuals as mentioned above, when measured with Doppler method, the mean SBP was 117.25 and Standard Deviation (SD) was 20.91, whereas the mean SBP with Pulse Oximetry method was117.38 and SD 21.47.When further analysed, for the Right Lower Limb Intraclass Correlation Coefficient (ICC) 0.999 which is highly significant was observed between these two methods.

The RABI (Right Ankle Brachial Index) was studied in 36 individuals as it was not possible in other individuals as mentioned above, where the Systolic Blood Pressure (SBP) when measured by conventional (Doppler method) the mean ABI was 0.941 and SD was 0.151, whereas the mean ABI with Pulse Oximetry method was 0.947 and SD 0.1517. When further analysed, for the RABI Intraclass Correlation Coefficient (ICC) 0.999 which is highly significant was observed between these two methods.

The LUL(Left Upper Limb) was studied in all individuals, where the SBP when measured by conventional method the mean SBPwas 125.22 and SD was 8.35, whereas the mean SBP with PulseOximetry method was 124.95 and SD 8.16. When further analysed, for the LUL Intraclass Correlation Coefficient (ICC) 0.999 which is highly significant was observed between these two methods.

The LLL(Left Lower Limb) was studied in 36 individuals as it was not possible in other individuals as mentioned above, where the Systolic Blood Pressure when measured by conventional method, the mean SBP was 115.03 and SD was 18.81, whereas the mean SBP with Pulse Oximetry method was 115.53 and SD 18.64.When further analysed, for the LLL Intraclass Correlation Coefficient (ICC) 0.999 which is highly significant was observed between these two methods.

The LABI(Left Ankle Brachial Index) was studied in 36 individuals as it was not possible in other individuals as mentioned above, where the SBP when measured by conventional method, the mean ABI was 0.922 and SD was 0.128, whereas the mean ABI with Pulse Oximetry method was 0.928 and SD 0.128. When further analysed, for the LABI Intraclass Correlation Coefficient (ICC) 0.999 which is highly significant was observed between these two methods.

Based on the above results, we can come to a conclusion that Pulse Oximetry method for the measurement of SBP and ABI in peripheral vascular disease is a good method and its values correlate well with the conventional methods and can be used as an alternative method for ABI measurement and thereby for diagnosis of PVD.

TAKAYASU ARTERITIS

All the 4 patients included in the study were between 30 to 40 years.

All are female patients.

All the patients in the study had Hypertension as their only comorbidity.

Table 7: Data of Takayasu arteritis group

AGE SEX	COMORBIDITIES	RUL- D	RUL-P	RLL-D	RLL-P	LUL- D	LUL-P	LLL-D	LLL-P
31 F	HTN	107	142	148	148	106	144	148	148
40 F	HTN	NR	144	152	153	NR	143	150	152
36 F	HTN	NR	NR	148	148	NR	NR	147	148
30 F	HTN	102	148	154	156	NR	148	156	156

This is the data collected for patients with Takayasu arteritis in the study. This data could not be statistically analysed as only in one individual the data could be measured in all four limbs.

In the first patient, the BP with the conventional method was on the lower side 107mm of Hg in R UL –D (Right Upper Limb – Doppler) whereas with pulse oximetry method in R UL – P(Right Upper Limb –

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Pulse Oximetry Method) the BP was on the higher side - 142 mm of Hg.

Similar results were obtained even with Left upper limb where the L UL- D (Left Upper Limb – Doppler) gave SBP of 106 mm of Hg and L UL – P (Left Upper Limb – Pulse Oximeter) gave SBP of 144mm of Hg. There was not much difference in SBP in right and left lower limb (LL) by Doppler (D) or Pulse oximetry (P) methods.

In the second patient, the SBP could not be measured using the conventional method – Doppler (D) method in both UL (upper limbs). With the Pulse oximetry (P) method, the SBP recordings could be measured and gave higher values, Right UL – 144 mm of Hg and Left UL – 143 mm of Hg. Both the lower limb SBPs could be measured with both methods and not much difference observed.

In the third patient, the SBP could not be measured with both the methods in bilateral upper limbs; both the lower limb SBPs could be measured with both methods and not much difference observed.

In the fourth patient, the Right Upper limb SBP with conventional method (Doppler) could be measured and was 102 mm of Hg whereas with Pulse Oximetry method (P) the SBP was 148 mm of Hg, in the Left Upper limb with Doppler (D) method, SBP could not be measured whereas with Pulse Oximetry method (P) the SBP was 148 mm of Hg. Both the lower limb SBPs could be measured with both methods and not much difference was observed.

Based on the present study findingsit can be concluded that Pulse Oximetry method of SBP measurement can be used for BP recording in Takayasu Arteritis cases where the pulse is usually not palpable and BP recordings are usually faulty or cannot be measured at all and HTN is usually underdiagnosed and mismanaged and they usually have high BP recordings and can lead to cardiovascular morbidity and mortality.

DISCUSSION

Blood Pressure is one of the vital signs and there are many methods in which BP can be measured. These includes Auscultatory Method, Palpatory Method, Doppler Method, Oscillometric Method, Finger Cuff Method, and Direct Intra Arterial Method. Pulse Oximeter is usually used for monitoring oxygen saturation levels and pulse rate. It is being used very commonly in hospital settings, nursing cares, ambulances, at home for monitoring purposes. Through our study we are putting forth that pulse oximeter can be used for the measurement of SBP by observing the reappearance of waveform pattern on deflation of sphygmomanometer cuff.

In our study, we measure SBP using the standard method of BP measurement and compare it with Pulse oximetry waveform reappearance method. Based on our analysis in the general population, the SBP measured using the Pulse oximetry method correlated well with conventional method and had high statistical significance as seen with p value which was less than 0.05 and Intraclass correlation Coefficient 0.998 in both limbs. Thereby we have a new method of measuring BP in individuals, which correlates with standard methods and gives accurate values.

In a study conducted by Chawla, 100 volunteers were studied where SBP was measured using Pulse Oximetry study, Auscultatory method, Oscillometric method in normotensive individuals. A volunteer had high BP recording and was excluded from the study. SPB using Pulse Oximetry, three readings per individual were taken, SBP-dis where the pulse wave pattern disappears on inflation, then SBP – app where the pulse wave pattern reappears on deflation and SBP-avg which is the average of these two values. In this study, the average of these two i.e., SBPavg was considered valid and correlated statistically well with both Auscultatory and Oscillometric methods.(2)

In our study, however, SBP was compared between the Auscultatory and pulseoximetry methods and Oscillometric method was not taken into consideration as that method is currently not being used in routine practice. Also the Pulse wave reappearance measurement of SBP is taken into consideration and not three readings as in the previous studies, as the reappearance SBP was proven to be more accurate in further studies after Chawla‟s. (4)(7)

A study conducted by Wallace, 46 children were taken who were post a cardiac procedure where BP monitoring is very important. Here the Pulse oximetry method was compared with oscillometric method and direct arterial BP measurement method. Measurements by all three methods was done at the same time. In pulse oximetry method, the disappearance, reappearance and average SBP values were taken into consideration. This study proved that SBP reappearance waveform method was best correlated and consistent with direct arterial method than with oscillometric study. In our study, we did not consider either of the methods as one is invasive and the other is not routinely practiced. Pulse Oximetry method can easily be used even in anesthetized, post-operative care patients and can help reduce the invasive methods of BP measurement.(7)Langbaum and Eyal conducted a study in neonates, pulse wave reappearance method also conducted similar study and found that SBP was consistent and correlated when measured with Pulse Oximetry reappearance, disappearance and average methods(8)

In another study by Talke,. in general population, SBP was measured by palpatory, auscultatory and pulse oximetry method whereas in patients in operating room, SBP was measured by Auscultatory, Doppler, Intra arterial and Pulse oximetry methods. In general volunteers, the Pulse Oximetry reappearance method correlated well in all methods, in anesthetized individuals, pulse oximetry reappearance method best correlated with Doppler method. However, this study was done in a very small study group. Our study

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done in more number of individuals, gives more consistent and accurate values and validation of pulse oximetry method with Auscultatory method is possible(4)

A study by Movius, studied in children post cardiac surgery compared SBP measurement by pulse oximeter, Doppler and oscillometer methods. Results of the study showed that pulse oximetry wave form SBP value was accurate with nearly same values when compared with the arterial catheterization methods than the oscillometric methods(9). Another study by Rajeev Vinayak compared SBP (reappearance of waveforms) with oscillometric method of SBP measurement in neonates in a hospital setting. In neonates, oscillometric method is better and standard when compared to other methods of BP measurement. This study has shown that SBP by pulse oximeter wave pattern return is more significant than disappearance and had better association with oscillometry method(10)

Both the studies were done in neonates and children, doesn't compare with the adult population or standard auscultatory method. Our study compares pulse oximetry method in adult population and with standard method thereby making it a more valid study for comparing methods and proving the accuracy of the methodology.

In a study conducted by Y Hellman, similar results as the other study by Kei Woldendorp and pulse oximeter SBP correlates better with Doppler method and also the previous study had a limitation of aortic valve opening which has been taken care of in this study(12)(11). However, it does not compare with standard auscultatory method as in our study.

In all the above studies, the study group was either in an operating room, post-operative care or in children or neonates or included a very small number of healthy volunteers. Also in most of the studies, the pulse oximetry method was compared with other methods but not standard Auscultatory method. In our study, all the said above limitations have been taken care of, where a bigger number though not significantly large, was taken as study population. The Pulse oximetry reappearance method was taken into consideration as it was already proved significant through previous studies and compared with standard Auscultatory method. Our study gave significant results as mentioned above, can be used for measuring SBP by reappearance method of Pulse oximeter.

In case of Peripheral Vascular Disease, our study first measured the SBP in all 4 limbs using Doppler method and then with Pulse oximetry method and then ABI is calculated. Our study included 60 individuals, of which 36 individuals ABI could be measured. Both methods correlated well and thereby proving that Pulse Oximetry pattern can be used instead of Doppler for ABI measurement and helps in the diagnosing of PVD, which is a cheaper, easier and feasible method. In smaller settings where Doppler is not available, Pulse Oximetry method will be the best method for ABI measurement and for diagnosis of PVD. A study was conducted by Par Samuelsson that studied 63 individuals of which 37 had PVD and the rest had no PVD. The Toe pressures were measured using Pulse oximetry method and by plethysmographic method. This study showed a good correlation between two methods and it can be used as an easy, cost effective and trust worthy method(13)(14).However, it not possible to get Plethysmography method done on a routine basis. No studies were done comparing Doppler method with Pulse Oximetry method in the past. Therefore, our study is new method of calculating ABI for diagnosis and assessingprogression of the disease, as mortality with PVD is high and needs early diagnosis and treatment.

Our study's secondary objective was to prove that pulse oximetry method can be used in the measurement of SBP in Takayasu Arteritis. In this condition, usually BP is either non recordable or faulty values are seen. With our study, we have shown that SBP can be measured in Takayasu Arteritis; however, sample size was too small to comment on the statistical significance.

CONCLUSIONS

- Through this study we conclude that Pulse oximetry reappearance of waveform method is accurate, easy, consistent and feasible to measure the Systolic Blood Pressure in general population.
- While this method can't replace Auscultatory method, it can be used as an alternate methodology and in Conditions where Korotkoff sounds are not easily heard or difficulty palpating the vessels like

- Edema
- Filariasis
- Plaster casts/bandages
- Noisy environment
- Low volume pulses
- Auscultatory gap can also be eliminated

- Pulse oximetry can also be used in Peripheral Vascular Disease patients, where Doppler might not be easily available in all settings, pulse oximeter can be used as an alternate method for ABI measurement. This study has proven that this method is reliable, easy, cost-effective and feasible and also useful in settings where Doppler method cannot be used.
- We also conclude that, Pulse Oximetry method of BP measurement can be used in Takayasu Arteritis cases for SBP measurement, where SBP can be measured even when conventional methods fail to record Blood Pressure. It is a novel method to record blood pressure.

LIMITATIONS

- Instrument based – the results may change based on the instrument, as many instruments are available.

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- In many cases, pulse oximeter probe could not be placed, hence the study could not be conducted in the individual to measure SBP using Pulse oximeter.
- Many more studies are necessary to validate this method of measuring SBP using Pulse oximeter before we can standardize this method as a newer method for BP measurement.

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