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OXYMETRY IN LEFT RING FINGER GIVES BEST RESULT IN PATIENTS WITH COVID-19!

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ABSTRACT

Pulse oximetry is a test used to measure the oxygen level (oxygen saturation) of the blood. It is an easy, painless measure of how well oxygen is being sent to parts of your body furthest from your heart, such as the arms and legs. The technique of pulse oximetry using spectrophotometric methodology measures oxygen saturation by illuminating the skin and measuring changes in light absorption of oxygenated (oxyhemoglobin) and deoxygenated blood (reduced hemoglobin) using two light wavelengths: 660 nm (red) and 940 nm (infrared).The ratio of absorbance at these wavelengths is calculated and calibrated against direct measurements of arterial oxygen saturation (SaO2) to establish the pulse oximeter's measure of arterial saturation (SpO2). Pulse oximetry is ubiquitously used for monitoring oxygenation in the critical care setting. By forewarning the clinicians about the presence of hypoxemia, pulse oximeters may lead to a quicker treatment of serious hypoxemia and possibly circumvent serious complications. Many people with COVID-19 disease have low levels of oxygen in their blood, even when they feel well. Low oxygen levels can be an early warning sign that people need medical care. The study conducted here aims to provide the comparison of peripheral capillary hemoglobin oxygen saturation (SpO2) values among every finger of the two hands. Total of Fifty patients between age of 18-65 years from General ward of Patients admitted with a positive result on RT-PCR or the Rapid Antigen Test available for COVID-19 were enrolled in the study. They were monitored for their SpO2 levels after 5 min of rest. After their blood pressure, heart rate, fasting time and body temperature were measured, SpO2 values were obtained from every finger and each of two hands fingers with the same pulse oximeter. All the patients enrolled for the study were exhibiting right hand dominance. The SpO2 values were obtained after at least 1 min of measurement period. A total of 500 SpO2 measurements from these 50 patients were obtained. The highest average SpO2 value was measured from left ring finger (97.04 % ± 1.07) and it was statistically significant when compared with right index finger and left index finger. The second highest average SpO2 value was measured from left little finger and it was statistically significant only when compared with left index finger (the finger with the lowest average SpO2 value) ($p < 0.05$). Based on the SpO2 measurement from the fingers of the both hands of these right handed dominant patients, we observed that, the left ring finger and left little finger have statistically significant higher value when compared with left middle and index finger in right-hand dominant patients. Similarly, among the right hand, the Right little finger followed by Right ring finger gave the most consistent results which further strengthen our assumption that Left ring finger and left little finger have the most accurate value that reflects the arterial oxygen saturation in patients with COVID-19.

BACKGROUND

The SpO2 reading on a pulse oximeter shows the percentage of oxygen in someone's blood. Measurements with this inexpensive and noninvasive method also provide heart rate and an indication of tissue perfusion (pulse amplitude).Pulse oximetry results may not be as accurate for people with darker skin. Their oxygen levels are sometimes reported as higher than they really are. This possibility should be considered when interpreting pulse oximetry results. Low perfusion (due to hypothermia, low cardiac output, increased systemic vascular resistance, profound anemia or etc.), venous pulsations in a dependent limb, excessive ambient light or motion can cause pulse oximetry artifact. Also, carboxyhemoglobinemia, methemoglobinemia and intravenous dyes can cause false SpO2 readings (Butterworth et al. 2013; Chan et al. 2013; DeMeulenaere 2007). Some COVID-19 patients suddenly develop the condition called "silent hypoxia," during which they still look and feel comfortable, but their SpO2 is perilously low. This happens to patients either in the hospital or at home. Low SpO2 may indicate severe COVID-19-related pneumonia, requiring a ventilator. SpO2 self-monitoring by patients with non-

severe COVID-19, discharged from the emergency department or an outpatient testing center, is an essential way to identify patients needing to return to the hospital for a further evaluation. There is no information in the current literature about which finger could give the highest or the reliable recording of SpO2 in patients with COVID-19. In this prospective study, we tested in COVID-19 patients if there is a difference of between fingers SpO2 values and focused if a particular finger could be utilised for SpO2 measurement as a standard protocol.

METHODS

After Institutional Ethics Committee approval and written informed consent was obtained, patients between age of 18-65 years from General ward where COVID-19 positive patients on RT-PCR or Rapid Antigen Test were admitted were included in the study. Patients who were smokers, pregnant or menstruating, having ulnar or radial arterial failure due to Allen test results, having hypotension, bradycardia, anemia or hemoglobinopathy, have nail polish in the fingers, were excluded from the study. Patients with an at least 8hr of fasting period were monitored after 5 min of resting. All SpO2 measurements were done in the same place by the same person in ambient light and the same brand monitor (Dr Trust, USA) was used in all the patients. All SpO2 values were recorded in the sitting position and simultaneous blood pressure, heart rate and body temperature were noted. Measurements of each finger (abbreviations for fingers used in the text are shown in Table 1) were recorded after waiting at least 1 min in between the recordings.

Table 1: Abbreviations for fingers.

Right thumb	R1
Right index finger	R2
Right middle finger	R3
Right ring finger	R4
Right little finger	R5
Left thumb	L1
Left index finger	L2
Left middle finger	L3
Left ring finger	L4
Left little finger	L5

Table 2: Profile of subjects in the study.

	Mean	SD
Age (years)	49.80	17.75
Height (cm)	163.07	9.33
Weight (Kg)	67.11	16.04
BMI	25.01	4.48
Temperature (°F)	86.11	23.45
Pulse (beats per minute)	77.64	7.23
Sex: F/M	15/35	

Statistical Analysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Continuous data was represented as mean and standard deviation. Repeated measures **ANOVA (Analysis of Variance)** was the test of significance to identify the mean difference. **Post Hoc Bonferroni test** was used to determine the intergroup analysis. **p value** (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

RESULTS

A total of 500 SpO2 measurements obtained from 50 patients. Demographic data and clinical profile of these COVID-19 patients are shown in Table 2. No complications like Hypotension, hypothermia, tachycardia, bradycardia were observed in any of the patients. There was no radial or ulnar artery insufficiency determined by Allen test, which was performed clinically. The average SpO2 values of each 10 finger were ranked as follows: L4 > L5 > L2 > R5 > L3 > R4 > R2 > R3 > R1 > L1 and listed in Table 3. Comparison of SpO2 values between fingers is shown in Table 3. Forty-five comparisons were done between fingers (Repeated Anova, F: 7.623, $p < 0.001$). The highest average SpO2 value was measured from L4 (97.04 % ± 1.07) and it was statistically significant when compared with R5 and L3. The second highest average SpO2 value was measured from L5 and it was statistically significant when compared with L1 (the finger with the lowest average SpO2 value).

Table 3: Multiple comparisons of repeated ANOVA by Bonferroni test.

	Mean	SD	R1	R2	R3	R4	R5	L1	L2	L3	L4
R1	95.93	2.16	-	-	-	-	-	-	-	-	-
R2	96.48	2.05	<0.001*	-	-	-	-	-	-	-	-
R3	96.43	2.24	0.655	0.01*	-	-	-	-	-	-	-
R4	96.71	2.30	0.036*	0.005*	0.011*	-	-	-	-	-	-
R5	96.75	2.07	0.01*	0.882	0.023	0.011*	-	-	-	-	-
L1	95.64	2.02	0.123	0.032	0.520	0.007*	<0.001*	-	-	-	-
L2	96.84	1.77	0.344	0.173	0.001*	0.014*	0.325	<0.001*	-	-	-
L3	96.73	1.82	0.004*	0.001	0.031*	0.172	<0.001*	0.001*	0.353	-	-
L4	97.04	1.72	0.001*	0.240	0.082	<0.001*	<0.001*	0.024*	0.949	0.349	-
L5	96.91	1.99	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.011*	0.096	0.125	0.487

Numbers are mean ± standard deviation or *P* values. $P < 0.05$: statistically significant. Repeated Anova, F: 7.623, p <0.001*

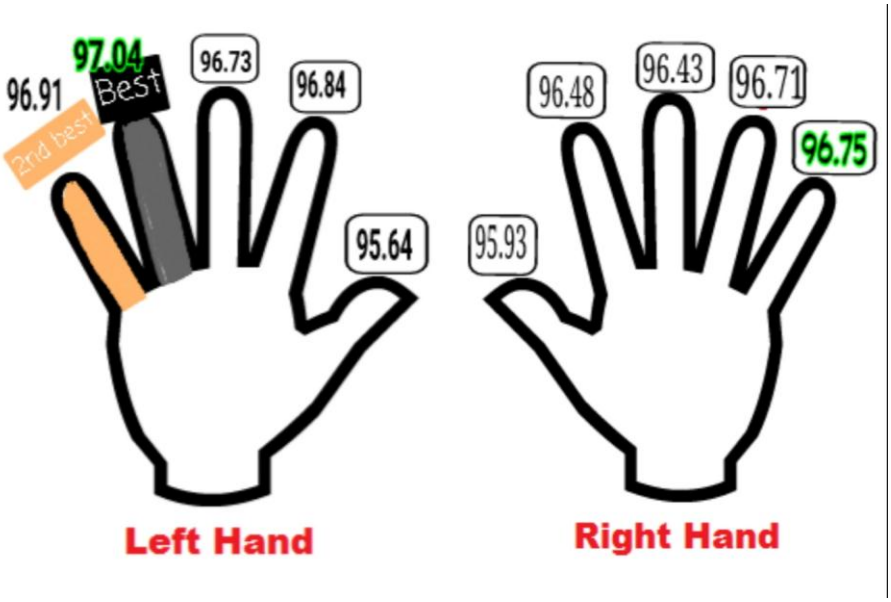

Fig. Pictoral representation showing best Mean SpO2 levels in the Ring Finger of the Left hand.

DISCUSSION

According to our results in 50 patients, L4 had the highest average SpO2 value with the pulse oximetry, while L5 had the second highest value. In a survey of health care workers for monitoring pulse oximetry, index finger was selected by 80 % for SpO2 measurement (Mizukoshi et al. 2009). Index finger dominantly is fed from deep palmar arcus created from radial artery. But middle fingers receive both ulnar and radial artery blood supply. Mizukoshi et al. have investigated the most suitable finger for the measurement of the pulse oximetric monitoring.

In this study, Perfusion Index (PI) value gave different results in each finger (ANOVA, $p < 0.01$) and the PI value of the middle finger was measured as the highest both during normoperfusion and hypoperfusion, but no remarkable difference was found in SpO2 values between fingers, which may be due to the insufficient number of subjects (20 volunteers).

Another study conducted by Basaranoglu et al. SpringerPlus (2015) 4:56 revealed that in right-handed dominant individuals, right middle finger and right thumb have the most accurate value that reflects the arterial oxygen saturation in normal healthy volunteers on whom the study was conducted. The difference of SpO2 recordings between different fingers may not be clinically important, but this knowledge may be valuable in conditions with poor peripheral perfusion. Higher perfusion may explain the highest value in L4. But, the explanation of the lowest value in L1 is a little complicated. The size of the finger may become a negative contributing factor that determines the SpO2 recording. Higher perfusion in the ring finger seems reasonable to expect the highest and most accurate SpO2 value.

CONCLUSIONS

According to the results of our study, we believe that the Left Ring finger has the highest and possibly the most accurate SpO2 measurements in patients with COVID-19 followed by the Left Little finger. In the Right hand however the Little finger emerged out to be the winner followed by the Ring finger. The highest SpO2 value can be taken as the maximum value that reflects the arterial oxygen saturation (SaO2).

Limitations of the study

The main limitation of our study was that we could not get any of the left hand dominant patients. Also, Males constituted a relatively larger part as compared to females. The sample size was relatively small. A larger sample size would reflect more accurate result.

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Conflicts of interest

There are no conflicts of interest.

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