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Effect of Nail Paint on Pulse Oximetry Values & Clinical Importance

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Abstract
We conducted a study to evaluate the changes in SpO2 on application of different nail paints. Our study included 80 parturients in labour room. Blue, black, brown, red and green colours were applied to the finger nails of both hands and the SpO2 values before and after the application of nail paints were studied. We found that there was a statistically significant decrease in the SpO2 values after the application of these nail colours. Black, blue, brown & green colour nail paint affected the SpO2 values readings more as compared to red colour nail paint. Although the differences noted were statistically significant, they were not clinically as significant.
Keywords: *SpO2 Desaturation; Finger nail paint; Labor cases; Clinical importance.*

Introduction

As per Indian Society of Anaesthesiologists & American society of anaesthesiologists during surgery & anaesthesia, pulse oximetry is one of the basic inclusions of the 'Minimum Mandatory Monitoring Guidelines'. Pulse oximeter is used for evaluating Oxygen saturation (SpO2) of haemoglobin& thereby oxygen status of patient in arterial blood. It has become one of the most common monitoring equipment at various clinical settings & units of hospital. Pulse oximetry is based upon two physical principles: a) The light absorbance of oxygenated haemoglobin is different from that of reduced haemoglobin, at the oximeter's two wavelengths, which include red and near infrared light; and b) The absorbance of both wavelengths has a pulsatile component, which is due to the fluctuations in the volume of arterial blood between the source and the detector. Given these two facts, clever engineering techniques have produced an invaluable monitor.

It provides continuous non-invasive monitoring of oxygen saturation of haemoglobin in arterial blood. Thus preventing consequences of desaturation & the complications there after. Increase in use of Pulse Oximeter in general wards is as common place as thermometer. Hospital nursing staffs have limited education in proper operation & usage of this device and have limited knowledge of how it works & what factors may affect the readings[(1)].

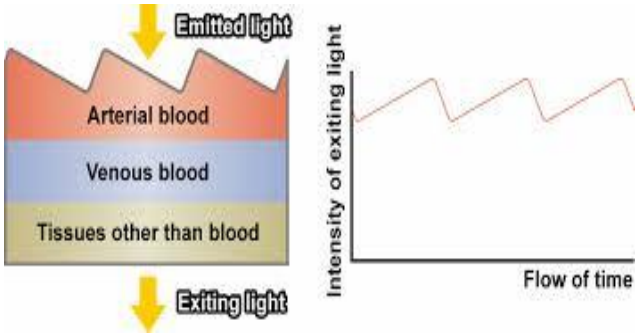

Diagram 1 showing the principle of Pulse oximetry

Confounding factors causing inaccurate or unobtainable SpO2: Bright light- [artificial or natural); Dyes &Pigments [Dark-colored nail polishes] (Carroll, 1997); Dirty sensors-(Sims, 1996); Dried blood over sensor (Woodrow,1999); Poor circulation/ Low Perfusion (Venous pulsations, Weak pulse); Cold extremities; Respiratory distress- illness or injury (COPD, Lung Cancer); Cardiac patients (Congenital cardiac defect) can confound the pulse oximeter readings.[2,3,4,5,6]

Women are often fond of applying various colours of nail paint. Finger & toe nails are painted with nail polish. SpO2 monitoring becomes difficult due to error in readings if posted for surgery. Removing Nail polish requires clinical time & supplies.

Materials & Methods

This is an observational prospective randomise single centre study. Our aims were to study 'changes in SpO2 values' on application of nail paint to fingers and to study differences in SpO2 values amongst corresponding finger of hands with & without nail paint.

After institutional ethics committee clearance was obtained, 80 emergency or elective patients in the age group of 18-35 years, with no nail paint on their fingers who were admitted to labor room for delivery, but with no fetal distress were included in the study. Patients with preeclampsia, eclampsia, diabetes mellitus, Sickle cell anaemia & thalessemia were excluded from the study. A finger pulse oximeter (Nellcor technology) was used for our study.

80 patients were selected for the study. After taking detailed medical and surgical history of the patients, a complete general and systemic examination was done. Routine investigations were done and noted.

Procedure of the study was explained to the patients. SpO2% of thumb, index, middle, ring & little fingers of right hand (without nail paint) & as well as left hand (without nail paint) were measured & noted before applying the nail colour. After proper cleaning & drying of nails, standard nail paints under study were applied to thumb, index, middle, ring & little finger of right hand as well left hand of the patients. The colours were randomly allocated to different fingers. Thumb-Blue; Index- Black; Middle-Red; Ring-Brown; Little finger-Green. On drying of nail polish, standard finger pulse oximeterprobe was applied & SpO2 values of fingers of both hands were noted.

Statistical analysis of values of SpO2 before and after applying nail paint were then analysed. Data was collected and compiled and analysed using EPI info (Version 7.2). Quantitative variables were both categorised and expressed in terms of percentage or in terms of mean and standard deviation. Difference between two proportions was analysed using Chi square or Fisher exact test. Difference between two means was tested using student T test. All analysis was two tailed and significance level was taken at 0.05.

Results

14 patients were in the age group of 18-20yrs; 40 in the age group of 21-25yrs; 22 in the age group of 26 - 30yrs & 4 in the 31-35 age group.

Table No-2: It shows that there was statistically significant difference in the reading of SpO2% without nail paint & after application of nail paint to fingers of right hand in all types of nail paint under study. (P- values- <0.001) [Right hand-Mean SpO2% decreased after nail paint: Blue

color- 0.52; Black- 0.6; Red- 0.36; Brown- 0.6; Green- 0.54].

Table No-3: It shows that there was statistically significant (P- values- < 0.001) difference in the reading of SpO2 % without nail paint & after application of nail paint to fingers of left hand in all types of nail paint under study. (P values< 0.001) [Left hand- Mean SpO2 % decreased after nail paint: Blue color- 0.58; Black- 0.69; Red- 0.42; Brown- 0.5; Green- 0.46].

Table No- 4: It shows that, there was no statistically significant difference in the SpO2 readings after application of nail paint to fingers of left hand & fingers of right hand in relation to respective nail paint colours to respective fingers of both hand.

Diagram2

Table 1

Age distribution (18-35 yrs)	No. of patients (80)
18-20	14
21-25	40
26-30	22
31-35	4

Table 2

Mean Oxygen Saturation % (+/- SD) Comparison: Before & After Nail paint (Right hand)			
Right hand	Before SpO2: Mean (SD)	After SpO2: Mean (SD)	p value
Thumb: Blue	97.77 (0.84)	97.25 (0.94)	<0.001
Index: Black	97.88 (0.84)	97.28 (0.95)	
Middle: Red	98.02 (0.78)	97.66 (1.03)	
Ring: Brown	97.80 (0.89)	97.20 (1.14)	
Little: Green	97.96 (0.81)	97.42 (1.21)	

p values: Highly significant.

Table 3

Mean Oxygen Saturation % (+/- SD) Comparison: Before & After Nail paint (Left hand)			
Right hand	Before SpO2: Mean (SD)	After SpO2: Mean (SD)	p value
Thumb: Blue	97.70 (0.83)	97.12 (1.07)	<0.001
Index: Black	98.07 (0.89)	97.38 (1.08)	
Middle: Red	97.97 (0.79)	97.55 (0.99)	
Ring: Brown	97.85(0.69)	97.35 (0.85)	
Little: Green	97.88 (0.88)	97.42 (1.01)	

p values: Highly significant.

Table 4

Change in Oxygen Saturation % (SD) Before & After Nail paint			
	Right Hand	Left Hand	p value
Blue	0.52 (0.82)	0.576 (0.77)	0.6460
Black	0.6 (0.70)	0.68 (0.78)	0.4102
Red	0.36 (0.95)	0.40 (0.78)	0.7045
Brown	0.57 (0.97)	0.50 (0.82)	0.9374
Green	0.53 (0.72)	0.46 (0.92)	0.6444

p values: Not significant.

Discussion

Pulse oximetry remains the standard of care in all clinical situations and its use for all patients under anaesthesia must be mandated. A closed claim analysis concluded that the incidence of critical incidents due to airway accidents declined in the 1980s since the introduction of pulse oximetry.[7] This led the ASA Standards for Basic Monitoring during anaesthesia to adopt pulse oximetry as of January1,1990.

To quote an editorial in Anaesthesiology". as the blindfolded anaesthetist walks unknowingly toward the cliff of hypoxia- whether due to

problems of inspired gas, equipment failure, under-ventilation, or abnormal pulmonary shunting - the protective hand of the pulse oximetry sentry stops him from falling over the edge".[8] Intelligent use of pulse oximetry can truly help save lives and prevent disasters due to hypoxic events.

In our study, on application of nail paint: Average mean decrease in SpO2% was: Black- 0.64; Brown-0.55; Blue colour-0.55; Green- 0.5; Red-0.39. Black, Blue, Brown &Green colour nail paint affected the SpO2 values readings more as compared to Red colour nail paint. There was no significant difference in SpO2 readings between corresponding fingers of opposite hand before & after application of nail paint. P-value was found to be highly significant on comparison of SpO2 readings before & after applying nail paint to fingers of left hand & right hand. Although the differences noted were statistically significant, they were not clinically as significant.

Cote CJ et al (1888) studies the changes in SpO2 readings after applying blue, green, purple, black, and red nail polish to the finger nails. They also found that black, blue, and green nail polish significantly lowered oximeter readings of oxygen saturation. In their study, blue and green produced greater decreases than purple and red; black produced an intermediate decrease; unlike our study, where black produced the maximum decrease.[9]

Desalu et al (2013) in their study, found that black and brown nail polish resulted in a significant decrease in SpO & hence dark coloured nail polish should be removed prior to SpO2 determination to ensure that accurate readings can be obtained.[10]

Hatice Sütçü Çiçek et al (2011) studied the effect of nail polish and henna on oxygen saturation determined by pulse oximetry in healthy young adult females. All the participants applied henna to one of their fingers a day before the study. Just before the study, one finger was left empty as control and the other fingers were dyed using various colours of nail polish (red, blue, beige, purple, brown, white, pink, green, colourless polish, light blue, light green and yellow). The mean saturations obtained from blue, beige, purple and white nail polished fingers were significantly lower than those of control and the other coloured fingers.[11]

Mallory MC studied the effect of nail colours on SpO2 readings. They studied red, yellow, dark blue, green, black, purple, fuchsia, light blue, brown, and white colours and found a small decrease in SpO2 (by approximately 2%) in fingernails painted with either brown or black fingernail polish when measured with the probe in the top-to-bottom position. However, placing the probe in a side-to-side position precluded any minor effects fingernail polishes may have on SpO2 and so may obviate the need to remove fingernail polish.[12]

Conclusion

To sum up, pulse oximetry remains the standard of care in all clinical situations and its use for all patients under anaesthesia must be mandated. As with all monitors one must be familiar with its performance characteristics, advantages and limitations. Early warning of hypoxic events helps the anaesthesiologist/ intensivist to take remedial action expeditiously, before irreversible organ damage occurs.[13]

From our study, we conclude that application of nail paint affects the digital pulse oximetry readings to some extent. There was statistically significant difference in SpO2 readings before & after application of nail paint; although this difference was not clinically significant. SpO2 readings were affected least by red colour & most by Black colour. So we may not waste time in removal of nail paint.

The limitation of our study is that it is based on a small sample size. To confirm the findings, similar study is suggested on larger sample size.

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