The effect of acrylic nails on the measurement of oxygen saturation as determined by pulse oximetry

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Pulse oximetry (Spo2) is a simple, noninvasive method that is widely used to determine oxygen saturation in patients undergoing surgical procedures. Artificial acrylic nails have recently become fashionable to strengthen and lengthen nails. This study investigates the effect of unpolished acrylic nails on the measurement of oxygen saturation by pulse oximetry.

Data were collected during a 3-month period. Thirty women, average age 32 years (range 18 to 61 years), were recruited at a high-volume nail salon in northwestern Pennsylvania. A baseline pulse oximetry reading was obtained on each subject's natural, unpolished fingernail using a Nellcor N-20/N-20P® portable pulse oximeter (Nellcor Incorporated, Hayward, California). A licensed nail technician applied the acrylic compound to the same finger. After the compound had hardened in approximately 5 minutes, a second reading was obtained on the unpolished acrylic nail.

The mean pulse oximetry reading at baseline was 97.33% and after acrylic nail application, 97.53%. Using a paired Student's t test, no statistically significant differences existed between readings.

This study demonstrates that unpolished acrylic nails do not affect pulse oximetry measurements of oxygen saturation. Patients may not need to remove unpolished acrylic nails before surgery.

Key words: Acrylic nails, oxygen saturation, pulse oximetry.

Introduction

Artificial nails have recently become fashionable (Figure 1). The most common are acrylic nails that are applied to strengthen and lengthen nails. The acrylic compound is a thermoplastic resin that is applied over the nail bed. Application costs from $50 to $70. Removal of an acrylic nail is difficult.
and time-consuming, requiring soaking the finger in acetone for 30 minutes. To date, no studies have examined the accuracy of pulse oximetry readings taken over acrylic nails. This study investigates the effect of unpolished acrylic nails on the measurement of oxygen saturation as determined by pulse oximetry.

Materials and methods
This study was conducted at a high-volume nail salon in northwestern Pennsylvania. The salon employed four licensed nail technicians who each averaged 10 clients per day. Thirty women, average age 32.1 years, (range 18 to 61 years) were enrolled in the study. Volunteers with a history of chronic obstructive pulmonary disease or vascular insufficiencies were excluded. All volunteers were informed about the nature of the study and signed a consent to participate.

Subjects were tested using the Nellcor N-20/N-20P® portable pulse oximeter (Nellcor Incorporated, Hayward, California). The pulse oximeter accurately and precisely measured arterial hemoglobin oxygen saturation in a range of 50% to 100%.

The pulse oximeter finger probe was placed directly on the unpolished nail bed. A cloth towel was placed over the finger to reduce the chance of ambient light influencing the reading. Each subject was instructed to breathe regularly and keep her hand still.

After the baseline reading was obtained, the probe was removed and a technician applied the acrylic compound (Tammy Taylor Acrylic Nails, Irvine, California) to the same nail bed, allowing 5 minutes to dry. A second pulse oximetry reading was recorded on the unpolished acrylic nail.

Means and standard deviations were calculated for pulse oximetry readings obtained before and after nail application. Differences between the means were analyzed using a paired Student's t-test with a prestudy alpha of $P<.01$.

Results
The mean pulse oximetry reading at baseline with an unpolished, natural fingernail was 97.33% and after acrylic nail application, 97.53% (Figure 2). The readings were not significantly different ($t = -.95, df = 29, P > .01$).

Discussion
Therapeutic interventions involving oxygen are based on oximetry readings.1,4 In anesthesia, pulse oximetry is an invaluable intraoperative tool to monitor oxygenation.

Pulse oximetry combines the principles of optical plethysmography and spectrophotometry. Optical plethysmography uses light absorption technology to reproduce waveforms from pulsatile blood. Spectrophotometry quantitatively measures light absorption through a given substance.2,5,6

A pulse oximeter consists of a finger probe with two light-emitting diodes (LEDs) at wavelengths of 660 nm (red) and 920 nm (infrared). The pulse oximeter determines the light absorbed when pulsatile blood is present, as well as absent at each wavelength. A photodetector placed opposite the LEDs, usually over the fingernail bed, measures the intensity of transmitted light across the pulsatile vascular bed. The difference in intensity of transmitted light at each wavelength is caused by the difference in the absorption of light by oxygenated and deoxygenated hemoglobin contained within the vascular bed.1,7 The pulse oximeter calculates the logarithm of this ratio utilizing the Beer-Lambert Law to determine oxygen saturation of arterial hemoglobin.1,5

Pulse oximetry also determines functional oxygen saturation; the ratio of saturated hemoglobin to the total amount of hemoglobin available for binding with oxygen (Figure 3).

The results of this study showed no significant difference in the measurements of oxygen saturation with natural nails versus unpolished acrylic nails. These results were consistent with the unpublished findings of Whalen.9 Whalen used an acrylic nail covering rather than applying acrylic nails in her study. A second unpublished thesis reported that unpolished, plastic press-on-nails affect oxygen saturation readings.10 In 1988, Rubin and Cote et al reported that polished nails caused
falsely low readings because blue and green pigments interfered with light absorption.11,12

This study found no statistically significant difference in Spo2 readings obtained at baseline and after acrylic nail application. These results are important because no set protocols have been established regarding the use of pulse oximetry in patients with artificial nails. Patients may not need to remove unpolished acrylic nails before surgery.

REFERENCES


AUTHOR

Stephanie M. Peters, CRNA, MSN, received her bachelor of science in Nursing from Vanderbilt University, Nashville, Tennessee, in 1981, and her master of science in Nursing from Gannon University, Erie, Pennsylvania, in 1996. She has traveled extensively around the world as a registered nurse with three international student programs: Up With People, Semester At Sea, and People To People High School Student Ambassador Program. Prior to graduate studies, she worked in the emergency department at University Medical Center in Jacksonville, Florida. She was also an adjunct faculty member at Florida Community College in Jacksonville. Ms. Peters is a staff nurse anesthetist at the Medical University of South Carolina in Charleston, South Carolina, and a clinical instructor for the College of Health Professions at the same institution.

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