Effect of Hemiparetic Stroke on Pulse Oximetry Readings on the Affected Side

Christine Roffe, MD; Sheila Sills, RGN; Kathryn Wilde, PhD; Peter Crome, MD, PhD

Background and Purpose—Hypoxia is common after stroke, and monitoring by pulse oximetry is suggested in the acute phase. Physical changes on the affected side or intravenous infusions may affect oximeter readings. This study was designed to test whether pulse oximetry recordings are the same on the affected and nonaffected sides in stroke patients.

Methods—Oxygen saturation (SpO₂) and heart rate (HR) were assessed simultaneously in the left and right hands in patients with hemiparetic stroke over a 3-hour period with 2 Minolta Pulsox-3i oximeters attached to the index fingers.

Results—Fifteen patients (53% men; 67% left hemiparesis; mean age, 73 years [SD, 7.5 years]) were recruited. HR and SpO₂ (12 measurements per minute) were monitored. The maximum difference between simultaneous left and right arm readings was 2% SpO₂, HR fluctuated more, but no affected/nonaffected side pattern was seen. Means for each patient of HR and SpO₂ for the affected and nonaffected sides were compared by t tests. Mean SpO₂ was 96% (SD, 1%) on both sides. Mean HR was 81 bpm (SD, 11 bpm) on the affected side and 80 bpm (SD, 10 bpm) on the nonaffected side. There was no significant difference between the 2 sides for either parameter (n=15; P=0.86 for SpO₂ and P=0.91 for HR).

Conclusions—Oximeters can be attached to either the affected or nonaffected side in hemiparetic stroke. (Stroke. 2001;32:1808-1810.)

Key Words: anoxia ■ hemiplegia ■ hypoxia ■ oxygen ■ stroke management

Patients who have suffered a stroke are prone to respiratory problems for a number of different reasons. These include alterations in the central regulation of respiration,1 sleep apnea,2,3 weakness of the respiratory muscles on the hemiplegic side,4-6 aspiration,7 chest infections,8,9 left ventricular failure,8 and pulmonary emboli.8,9 While routine oxygen supplementation cannot be recommended by current evidence,10 treatment guidelines for acute stroke unanimously support treatment of hypoxia.11,12 The European Ad Hoc Consensus Group suggested that all patients with acute stroke should have their oxygen saturation monitored continuously or at frequent intervals.12 Pulse oximetry allows oxygenation to be monitored continuously and noninvasively.13

Motion artifact can be a major problem in the interpretation of oximeter readings.13-17 In patients with stroke, such problems may be reduced by placing the oximeter probe on the affected side. However, there is no published evidence confirming that readings on the affected and nonaffected sides are comparable. Stroke-related edema, changes in vasomotor tone, and skin temperature may potentially alter oximeter readings on the affected side. Many patients with a stroke will have an intravenous drip in situ within the first few days, and this may also affect readings.13-17

This study was designed to test whether oxygenation, as assessed by pulse oximetry, is the same in the affected and nonaffected sides in hemiparetic stroke patients.

Subjects and Methods

Adults with acute hemiparetic stroke were recruited over a period of 19 weeks. The researcher interviewed the patients within 72 hours of their admission to hospital. Patients who were moribund, those who refused consent, those with mild hemiparesis (power ≤2/5),13 those with poorly perfused limbs or very thick nails, and those in whom finger probes could not be placed or who were too restless to keep the probes in situ were excluded. Intravenous infusions were not a contraindication as long as the flow rate was <1 L over 8 hours. Patients were either sitting or lying down. Hands were inspected to ensure that the fingers were warm and well perfused. Nail varnish was removed and long fingernails were clipped, when necessary. Excessive ambient lighting was turned off or reduced by screens. Pulse oximeters (Pulsox-3i, Minolta, and Oximeter DownLoad software for Windows, Stowood Scientific Instruments, Beckley) were attached to both wrists and secured with tape. The sensory probes were fitted to the index fingers. Measurements were performed for 3 hours, between meals, with the patient resting. The patient was observed by the researcher to detect and record arm movements, which might result in recording artifacts. No blood pressure measurements were taken during the time of the study.

Values for oxygenation (SpO₂) were obtained by performing a moving average for the last 5 seconds, updated every second. Those for heart rate (HR) were obtained by performing a moving average for the last 8 bpm, updated every second. Descriptive data analysis was performed on Microsoft Excel for Office 2000. Statistical tests were conducted in SPSS version 10 for Windows.

Results

During the recruitment period, 225 patients with acute stroke were seen by the research nurse. Of those, 132 were excluded.
because >72 hours had passed since their stroke, 16 were excluded because of reduced consciousness, none were excluded because of poor peripheral perfusion, 4 were excluded because of confusion or restlessness, 15 were on oxygen treatment, and 43 had no limb weakness. Fifteen patients matched the inclusion criteria and were recruited to the study. None of the participants dropped out during the study. All oximetry traces were interpretable and could be used for the final analysis.

Fifteen patients (8 men [53%], 7 women [47%]; 10 left hemiparesis [67%], 5 right hemiparesis [33%]; mean age, 73 years [SD, 7.5 years]; median Glasgow Coma Scale score, 15 [range, 6 to 15]) were included in the trial. Seven subjects (47%) had total anterior circulation syndrome, 4 (27%) had a partial anterior circulation syndrome, and 4 (27%) had a lacunar syndrome.19 A CT of the head showed cerebral infarcts in 11 of the subjects (8 cortical, all involving the parietal cortex; 3 lacunar) and a cerebral atrophy in 1 (clinically a lacunar stroke). Three patients died before a CT scan could be performed; clinically all 3 had total anterior circulation syndromes. Seven patients (47%) had an intravenous infusion in situ, 4 on the affected side and 3 on the nonaffected side.

The raw oximetry results (12 measurements per minute) for HR and SpO₂ for the left and right hands were first examined for each patient individually. There was never >2% difference in the SpO₂ readings obtained simultaneously on the left and right sides. This equates to no difference since the constraints of the precision and accuracy of the equipment were ±2% for SpO₂. HR is more sensitive to artifacts and showed greater variation in the left and right readings. There was, however, no pattern of either the left or right or affected/nonaffected side being consistently higher or lower.

The mean and SD values of HR and SpO₂ for the left and right sides over the 3-hour period for each patient are shown in the Table. The mean SpO₂ was 96% (SD, 1%) on the affected side and 96% (SD, 1%) on the nonaffected side. The mean HR was 81 bpm (SD, 11 bpm) on the affected side and 80 bpm (SD, 10 bpm) on the nonaffected side. The mean results of HR and SpO₂ over the 3-hour period on the affected and nonaffected sides of all patients were compared by Student’s t tests. There was no significant difference between the 2 sides for either parameter (n = 15; P = 0.86 for SpO₂ and P = 0.91 for HR).

In the 7 patients who had an intravenous drip in situ, there was no significant difference in oximetry readings between the drip arm and the nondrip arm (P = 0.44 for SpO₂ and P = 0.96 for HR [Student’s t test]).

Discussion

In hemiparetic stroke patients, the results of pulse oximetry are not affected by the side to which the probe is attached. The pulse oximetry recordings are not affected by the presence of an intravenous infusion running at a standard rate. Pulse oximeters can therefore be attached to either the affected or nonaffected side. Since there is likely to be less movement artifact on the affected side, placement of the oximetry probe on the affected side is recommended.

Acknowledgements

This study was supported by a grant from the North Staffordshire Medical Institute. We would like to thank the North Staffordshire Medical Institute for their generous support of the study. We would also like to acknowledge all study participants, without whose personal input this study would not have been completed.

References

Effect of Hemiparetic Stroke on Pulse Oximetry Readings on the Affected Side
Christine Roffe, Sheila Sills, Kathryn Wilde and Peter Crome

Stroke. 2001;32:1808-1810
doi: 10.1161/01.STR.32.8.1808
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2001 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/32/8/1808

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org/subscriptions/