

Health-Related Quality of Life in Patients on Home Oxygen Therapy with Telemonitoring

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ABSTRACT

Home oxygen therapy (HOT) is an important treatment for patients with chronic respiratory diseases. Recently, telemonitoring of HOT has become available. In the present study, we examined whether telemonitoring of HOT could improve health-related quality of life (HRQOL). Twelve patients receiving HOT participated in this study. The oxygen flow rates, use of the oxygen concentrator, and the values of percutaneous arterial oxygen saturation measured by each patient with a pulse oximeter were checked using a telemonitoring system for a period of one month. Interventions based on the results obtained were carried out in order to optimize oxygen use in this patient cohort. We evaluated the results of the SF-36 questionnaire before the initiation of telemonitoring and at 3 months after completion of the study. We identified significant improvements in SF-36 sub-scores after completion of this intervention. We conclude that telemonitoring may be a useful method to improve HRQOL.

Key words arterial blood oxygen saturation; chronic respiratory failure; home oxygen therapy; pulse oximetry; quality of life

Home oxygen therapy (HOT) in patients with chronic respiratory failure is an important medical treatment that improves both the quality of life (QOL) and prognosis by providing long-term oxygen therapy at home.^{1, 2} Recent studies revealed that continuous oxygen inhalation for patients with chronic obstructive pulmonary

disease (COPD) with chronic respiratory failure was economically more cost effective³ and was associated with a substantially better prognosis⁴ than oxygen therapy provided at night only. However, some patients do not take in sufficient oxygen while at home; the frequency and degree of hypoxia in patients with HOT remains unclear. Recently, a means of telemonitoring patients on HOT has been developed which will permit health care providers to monitor the use of oxygen concentrator and to review percutaneous arterial blood oxygen saturation as measured by pulse oximetry (SpO₂). In this preliminary study, we examined the use of telemonitoring of HOT to determine whether this intervention resulted in improved health-related quality of life (HRQOL) in these patients.

SUBJECTS AND METHODS

Patients

Twelve patients (nine males and three females; 76.0 ± 9.8 years) receiving HOT for more than one year were recruited to participate in this study. Underlying diagnoses included: COPD (*n* = 5), sequelae of tuberculosis (*n* = 3), interstitial pneumonia (*n* = 2), bronchiectasis (*n* = 1), and scoliosis (*n* = 1). No patients were hospitalized during the study. The study was approved by Tottori University and the Hitachi Memorial Hospital ethical board (approval number 1636 and 17A006). All participants provided written informed consent.

Telemonitoring

Telemonitoring is a relatively new medical tool that has emerged from recent developments in information and communication technology. These devices are connected via standard mobile-based internet and the operating status and biological information are sent automatically and saved to a cloud server in a time series database. The physician can access and analyze these data at any time using his or her computer. In this study, we measured oxygen flow, use of the oxygen concentrator (FH-100/5L, Fukuda Denshi, Tokyo), and values of SpO₂ and pulse rate via a pulse oximeter (Anypal,

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Abbreviations: BP, bodily pain; COPD, chronic obstructive pulmonary disease; GH, general health; HOT, home oxygen therapy; HRQOL, health-related quality of life; MH, mental health; PF, physical functioning; QOL, quality of life; RE, role emotional; RP, role physical; SF, social functioning; SF-36, Medical Outcome Study 36-Item Short Form Health Survey; SpO₂, percutaneous arterial blood oxygen saturation measured by pulse oximetry

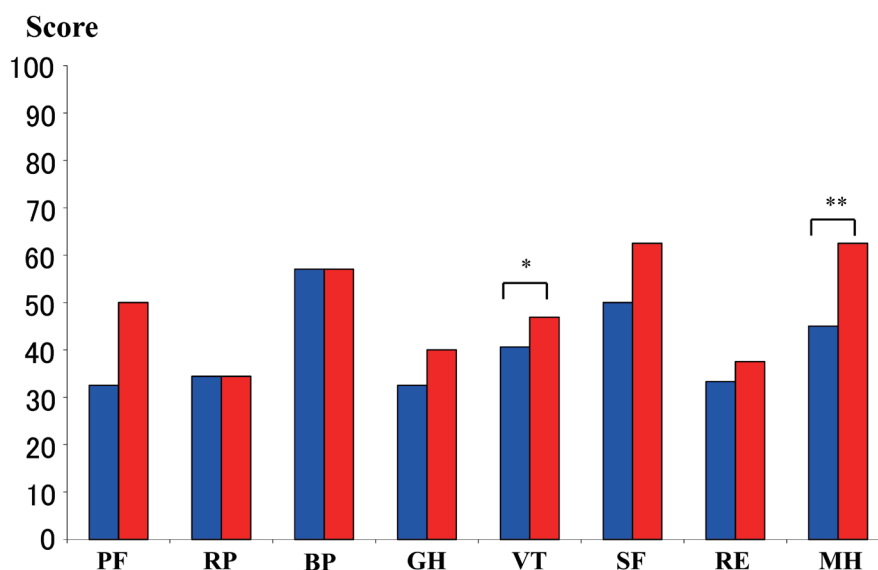


Fig. 1. Scores on the SF-36 questionnaire before (blue bar) and after telemonitoring trial (red bar) from patients on home oxygen therapy. Shown are the median values, $n = 12$, $*P < 0.04$ and $**P < 0.02$ using Wilcoxon matched-pairs signed rank test. SF-36, Medical Outcome Study 36-Item Short Form Health Survey. PF, physical functioning; RP, role physical; BP, bodily pain; GH, general health perception; VT, vitality; SF, social functioning; RE, role emotional; MH, mental health.

Fukuda Denshi). Data collected over a 1-month period were monitored at least every week by a physician using a dedicated telemonitoring system (Fukuda Home Management System, Fukuda Denshi). Interventions designed to improve respiratory parameters were carried out intermittently based on the results obtained.

Health-related QOL

The Medical Outcome Study 36-Item Short Form Health Survey (SF-36) questionnaire is a validated tool used to measure HRQOL. In the SF-36, one item is designed to assess perceived change in health status, and each of the remaining 35 items contributes to the score on one of eight scales: physical functioning (PF), role physical (RP), bodily pain (BP), general health perception (GH), vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH). Scores on these eight scales were used to compute a summary index of physical health and a summary index of mental health.^{5,6} We examined each study participant using the SF-36 questionnaire before telemonitoring of HOT and again 3 months later.

Statistical analyses

The values are presented as the median. We used Wilcoxon matched-pairs signed rank test to determine significant differences in SF-36 scores determined before and after telemonitoring of HOT (StatFlex,

ViewFlex, Tokyo, Japan). Differences were considered to be statistically significant at $P < 0.05$.

RESULTS

Among the 12 HOT patients in our study, four required continuous oxygen therapy. We found that four of the patients required more inspired oxygen at rest as hypoxia was recognized by the values of self-measured SpO_2 provided. Similarly, we found that five patients needed more oxygen during exercise. Appropriate interventions were made in each case. Particularly, the median time of oxygen inhalation was increased from 12.7 to 21.7 hours after appropriate interventions. Figure 1 presents the median scores of SF-36 questionnaire before telemonitoring began and scores from the same patients at 3 months later. Scores that evaluate VT and MH underwent significant improvement after the telemonitoring period ($P < 0.04$ and $P < 0.02$, respectively).

DISCUSSION

We were able to respond acutely to the need to adjust oxygen flow among the patients participating in our telemonitoring study. Appropriate interventions, including increasing inhalation time and/or altering the flow rate, were associated with improved scores on the SF-36 questionnaire.

The efficacy of telemonitoring of patients receiving HOT remains unclear. Segrelles Calvo and colleagues⁷

reported that telemonitoring of blood pressure, SpO₂, pulse rate and peak flow from the patients with severe COPD receiving HOT significantly reduced the number of emergency room visits, number of hospitalizations and length of hospital stay (PROMETE study). As a part of this study, the patients were advised to visit a hospital when telemonitoring identified a possible exacerbation of COPD. Telemonitoring that includes SpO₂ in association with physical activity might contribute to a more precise and appropriate understanding of oxygen needs⁸ and home-based health care providers capable of telemonitoring patients with COPD reported effective improvements in HRQOL.⁹ By contrast, Ancochea and colleagues¹⁰ reported that remote patient management using telemonitoring of blood pressure, SpO₂, pulse rate, respiratory rate and spirometry from severe COPD patients receiving HOT did not result in reductions in COPD-related emergency room visits or hospital admissions. Since the patients receiving HOT are generally those with severe disease, it may be important to focus on the selection of suitable patients who can adapt to and function with telemonitoring. In this study, we found that the telemonitoring of HOT resulted in significant improvement of several of the sub-scores within the SF-36. As such, improvements in HRQOL may be directly related to this intervention, although other factors preclude a definitive conclusion on this subject at this time. This preliminary study is associated with several limitations, most notably small sample size, and we did not consider the control group that did not use telemonitoring of HOT. Further study will be needed to clarify the usefulness of telemonitoring of HOT and the resulting impact on HRQOL.

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The authors declare no conflicts of interest.

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