Use of video-based education and tele-health home monitoring after liver transplantation: Results of a novel pilot study

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Background. *In this observational study, we analyzed the feasibility and early results of a perioperative, video-based educational program and tele-health home monitoring model on postoperative care management and readmissions for patients undergoing liver transplantation.*

Methods. *Twenty consecutive liver transplantation recipients were provided with tele-health home monitoring and an educational video program during the perioperative period. Vital statistics were tracked and monitored daily with emphasis placed on readings outside of the normal range (threshold violations). Additionally, responses to effectiveness questionnaires were collected retrospectively for analysis.*

Results. *In the study, 19 of the 20 patients responded to the effectiveness questionnaire, with 95% reporting having watched all 10 videos, 68% watching some more than once, and 100% finding them effective in improving their preparedness for understanding their postoperative care. Among these 20 patients, there was an observed 19% threshold violation rate for systolic blood pressure, 6% threshold violation rate for mean blood glucose concentrations, and 8% threshold violation rate for mean weights. This subset of patients had a 90-day readmission rate of 30%.*

Conclusion. *This observational study demonstrates that tele-health home monitoring and video-based educational programs are feasible in liver transplantation recipients and seem to be effective in enhancing the monitoring of vital statistics postoperatively. These data suggest that smart technology is effective in creating a greater awareness and understanding of how to manage postoperative care after liver transplantation. (Surgery 2016;160:869-76.)*

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Liver transplantation (LT) remains one of the most complex surgical procedures performed and. as such, consumes substantial personal, institutional, and community resources. Due to the continued organ shortages and advances in medical care, operative technique, and bridging therapies, patients are undergoing LT in a profoundly debilitated state.[1,2]

Postoperative care remains critical in this patient cohort because increasing stress, poor quality of life, and challenges that recipients face in the immediate, post-transplant setting make it seemingly impossible for these patients to recover successfully after LT. It is an unfortunate reality that readmission rates after LT remain high, while patient satisfaction and adherence is not optimized.[3-6] A national analysis of readmissions after LT demonstrated 30-day readmission rates as high as 38%, which increased to 48% at 90 days.[7] Our institutional data demonstrated a 30-day readmission rate of 41% and long-term readmissions (within 1 year of LT) occurring in 69% of recipients.[6] Despite this level of burden placed on the health care system, the care of LT recipients has not evolved to entail high utility of information

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technology, personalized care, and mechanisms to improve outcomes.

Tele-health and other electronic tracking devices afford the opportunity to increase early involvement and communication between patients and surgical providers. Some success has been seen in the ambulatory operation setting through the use of tele-health, with feasible implementation in postoperative patients and improved postoperative wound monitoring being demonstrated[8,9]; however, there has not been any application of such technologies after complex surgical procedures such as LT.

Through a novel pilot study utilizing a tablet-based monitoring system, we have enabled real-time monitoring of postoperative patients, allowing for early detection of concerning trends and early implementation of interventions necessary to support the at-home care of post-transplant recipients.[10] In addition, we developed video-based education modules for LT recipients to access in the immediate pre- and postoperative periods. We aimed to create a patient-centered model of post-transplant care that improves patient outcomes including daily vital statistics and readmission as well as patient satisfaction.

Our pilot study consisted of 20 consecutive LT recipients, and we have reported their results in the following section. Because of the limited number of patients enrolled in this study, we are unable to draw statistical conclusions regarding the efficacy of tele-health over the standard of post-transplant care; however, we hope to demonstrate the feasibility of implementation and the potential benefits this program may provide to this cohort of patients.

METHODS

Twenty consecutive patients undergoing LT at University of Cincinnati Medical Center (UCMC) between September 2014 and February 2015 were enrolled in a nonrandomized pilot study at discharge to home. Patients were enrolled consecutively during this time with the exception of 3 patients due to death, refusal, and lack of long-term evolution (LTE) coverage at their place of residence. Patients participated in remote care, postdischarge monitoring through the use of smart tablets connected to Bluetooth vital statistics peripherals.

The defined study period lasted for 90 days postdischarge and was designed to address the acute postoperative needs after LT. Smart tablets equipped with LTE coverage were provided for all participants. A tracking program configured to measure vital signs was used to monitor daily temperature, blood pressure, blood sugar, and weight readings. All devices were returned after the 90-day study period. All smart technology and support was provided by Intel-GE Care Innovations, LLC (Roseville, CA). The University of Cincinnati Institutional Review Board approved this study.

Prior to LT, patients participating in this pilot study underwent the standard listing and workup procedure typical of UCMC. In addition to established written educational materials, these patients were provided access to an educational video program developed by the transplant team. Videos consisted of 10 short films discussing various important, post-transplant topics, including wound care, adherence to medication, nutrition, blood glucose control, signs of rejection, and others.[11] Videos were made available to all patients undergoing LT at UCMC, including those not enrolled in the pilot study, and were accessible through the website of the University of Cincinnati transplant program.

Objective data of vital statistics were collected daily using Bluetooth peripherals for each patient for the first 90 days postdischarge. These data included patient heart rate (HR), systolic blood pressure (SBP), blood glucose (BG), body weight, and temperature. Vital statistics were monitored daily with emphasis placed on readings outside the normal range (threshold violations). Violations were flagged for each measurement type based on the following thresholds: HR ($\leq$60 beats/min or $\geq$100 beats/min), SBP ($\leq$100 mm Hg or $\geq$150 mm Hg), BG ($\leq$70 mg/dL or $\geq$300 mg/dL), body weight ($\geq$2% fluctuation in total body weight within 48 hours), and temperature ($\leq$97°F or $\geq$100.6°F).

Obvious erroneously entered values for each vital statistic (ie, SBP <20 mm Hg, weight <40 lbs, etc) were excluded from the overall data set (n = 105) and represented <1% of all entries. Assessment of daily health questions, tasks to watch specific educational videos, and quizzes pertaining to topics covered were asked of patients through daily prompts via the smart tablet. Patient readmission data were collected prospectively for each patient. Readmissions within 90-days of LT and reasons for readmission were recorded for each patient.

Questionnaires of patient satisfaction and effectiveness of this program, including educational videos and tele-health home monitoring, were collected retrospectively for analysis with 19 of 20 participants responding. The questionnaire focused on the effectiveness of video education, patient satisfaction with LT education, and satisfaction with post-transplant care and medical professionals. Lastly, patients were asked to rate their