Geriatric Nursing 35 (2014) S3–S10

Contents lists available at ScienceDirect

Geriatric Nursing

journal homepage: www.gnjournal.com

Feature Article

Measuring activity levels associated with rehabilitative care in hospitalized older adults

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Keywords:
Activity Monitoring
Accelerometry
Hospitalization
Inactivity
Older Adults

A B S T R A C T

Older adults often experience functional losses during hospitalization. Clinical care activities have been increasingly promoted as a way to help older hospitalized patients offset these losses and recover from acute illness. Little research exists to objectively measure clinical care activities. This study evaluated the utility and feasibility of using the Actiheart™, a combined heart rate monitor and accelerometer, to measure heart rate and motion (activity counts) during five clinical care activities. Fifty-four adults, aged 65 and older, scheduled for surgery, participated in a simulation of activities. The Actiheart™ successfully measured motion and heart rate during each of the five activities. One-way repeated measures analyses of variance showed that the Actiheart™ discriminated significant differences within and across the five activities. This study supports the use of an activity monitor to quantify clinical care activities in research studies that can be translated into clinical care. However, the complexity associated with data collection and analysis using the Actiheart™ could limit its direct use in clinical research.

Hospitalization presents a major risk for older persons, particularly the very old, who often suffer an irreversible decline in functional status that persists beyond their hospital stay.[1–3] Bed rest often accompanies hospitalization, regardless of a patient's primary illness.[4] The resulting deconditioning impairs recovery and puts older adults at increased risk for subsequent disability and mortality.[5,6] Critical illness, requiring an intensive care unit (ICU) stay, further exacerbates the risk of post-hospital functional decline.

Overall, the problem of inactivity in older hospitalized patients, and the adverse physical, functional, economic, and social consequences are well established.[7,8] Although patient mobilization is increasingly promoted as a clinical goal and part of recovery for all patients,[9–11] studies have shown that many patients still spend much of their hospitalization in bed.[12–15] Safety concerns, multiple device access, sedation, time constraints, staffing, and cost have all been associated with the increased risk of inactivity that occurs in the hospital setting, particularly in the ICU.[16]

Increasingly, research has focused on incorporating activity early during hospitalization, using either formal physical therapy sessions or through clinical care activities that occur as part of routine nursing care, like turning in bed or transferring.[17–19] Recent studies have shown even mechanically ventilated patients can benefit from activity interventions.[12,15,20–23] A variety of early activity interventions during hospitalization have even been shown to influence outcomes such as length of stay and time to first mobilization.[15] However, despite the assumed importance of activity-based interventions, particularly in older adults, little progress has been made in defining and measuring meaningful activity.[24]

Monitoring approaches that have been used to track activity have generally been invasive, using arterial and venous catheters[25,26] or subjective, relying upon observation, nurse recall, or chart review.[27,28] A valid and reliable noninvasive measure of activity, especially clinical care activities, is lacking. Accelerometry, using a non-invasive device to detect accelerations (called 'motion' hereafter), has been used minimally in the hospitalized population. Prior studies using accelerometry to measure activity in the ICU setting have been limited by narrow observation periods, small samples, and measurement of only a partial sampling of selected progressive activities.[26,29,30]

What was not yet known prior to this study was whether one type of accelerometer, the Actiheart™, an accelerometer that collects continuous motion and heart rate data simultaneously, was sufficiently sensitive to differentiate patterns of motion and heart

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0197-4572/$ – see front matter © 2014 Mosby, Inc. All rights reserved.
http://dx.doi.org/10.1016/j.gerinurse.2014.02.014

rate in relatively low-intensity activities (e.g., turning, dangling) typical of activities of hospitalized older adults. The purpose of this study was to use an objective, noninvasive approach to measure simulated clinical care activities in a sample of older surgical patients as a first step toward systematically measuring low-intensity activities that are commonly used in hospital-based activity interventions. The primary aims of this study were to use the Actiheart™ to describe and compare the patterns of motion and heart rate during five clinical care activities.

Methods

Study design

This study used a descriptive, within-subjects design to describe simulated activities of older subjects in a university-affiliated medical center during a 7-month interval (March to October 2008).

Sample, setting, and recruitment

Patients 65 years and older who had a planned major surgery requiring overnight hospitalization were recruited for the study through the hospital pre-admission testing (PAT) clinic. Because the device had not previously been tested in an older population nor in an inpatient setting, the methodologic nature of the study necessitated a more controlled environment than that afforded in an actual inpatient ICU setting. The sample was selected because these patients were identifiable prior to their hospital admission and represented older adults whose hospitalizations often include an ICU stay. Using published heart rate data as a proxy for less available motion data and for the activity of turning, one of the activities thought to cause the least amount of change in heart rate, the study required a sample of 53 subjects for 80% power at the 0.05 level of significance to detect a significant difference of heart rate and motion within and across activities.

Eligibility criteria included patients who: 1) had a planned major surgical admission requiring a PAT appointment; 2) were oriented to person, time, and place; 3) were able to speak English (required to follow directions and for consent); 4) were ambulatory or physically able to participate in the study; and 5) had approval of their surgeons to participate. The study was approved by the university institutional review board and all subjects provided informed consent.

Preliminary screening of patients was completed by designated PAT nursing staff or the principal investigator (PI) prior to the patient's pre-surgical appointments at the PAT clinic. PAT nursing staff contacted all potentially eligible patients by telephone. If a patient granted permission to be contacted, the PI telephoned the patient to explain the study in detail, review eligibility criteria, and determine the patient's interest in participating.

Study procedures

A single study visit occurred during which time consent was obtained, clinical data were collected, and the simulation protocol occurred. The study visit was separate from the PAT appointment. A questionnaire was used to measure subject characteristics, comorbidity, and functional status, and clinical data, such as height and weight, were also collected. Study appointments were completed by the PI or three research assistants (RA), all graduate nursing students, according to standard operating procedures.

The average total study appointment was approximately 60–90 min and took place in a designated study room set up to replicate aspects of an ICU environment, including hospital bed and monitor. Equipment commonly used in the ICU setting was attached to each subject noninvasively for the simulation portion of the protocol to simulate the type of interference that occurs with activity during hospitalization, including: cardiac leads, venous and Foley catheters, sequential compression devices, and oxygen tubing. Two types of accelerometers, the Actiheart™ and Actical®, were attached to each subject to measure the primary outcomes of heart rate (Actiheart™) and motion (Actiheart™ and Actical®). A video was used to record each set of simulated activities to assist in interpreting the accelerometry data. Each subject wore a lead apron equal to 10% of each subject's weight to simulate the increased difficulty in spontaneous movement in the ICU.

The simulation protocol included the following five activities in the same order for all subjects: 1) rolling side to side with a linen change (turning); 2) transferring from a supine to seated position at the side of the bed (dangling); 3) transferring from a seated position on bed to a straight back chair (transferring); 4) sitting in a chair (sitting); and 5) rising from a chair and walking with either walker or IV pole (walking). Subjects rested prior to and between each activity in order to achieve baseline motion and heart rate levels and were allowed enough time to complete each activity at their own pace.

Measures

Measures of motion and heart rate

Motion and heart rate responses to the five clinical care activities were measured using the Actiheart™ (model 910-0023-01, Mini Mitter, Bend, OR). The Actiheart™ measured the primary outcome variables of heart rate and motion. The Actiheart™ consists of a two-lead electrode sensor system placed near the sternum and along the mid-clavicular line to record both motion and heart rate simultaneously during the activity simulation protocol (see Fig. 1). A single Actiheart™ was used on all subjects. The Actiheart™ is a variation of the traditional accelerometer, such as the Actical®, which is a wristwatch-like device worn on the wrist, ankle, or waist to collect data generated by body movements. The Actical®, worn on the wrist in this study, produced an event marker/time stamp that was used to enhance the reliability and validity of the Actiheart™ by verifying the occurrence and duration of each activity period.

Data from accelerometers are scored automatically using predetermined computer algorithms, with motion, or accelerations, recorded in 15-second intervals called epochs. Data are reported in counts per minute (cpm) and heart rate recorded in beats per

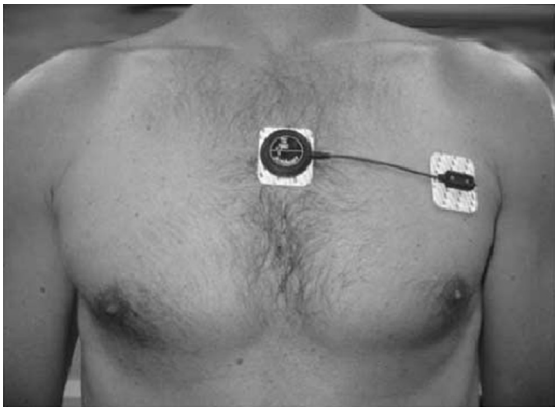

Fig. 1. The Actiheart™. Taken from Brage S, Brage N, Franks PW, Ekelund U, Wareham NJ. Reliability and validity of the combined heart rate and movement sensor Actiheart. Eur J Clin Nutr 2005;59(4):561–70. Used with permission from Copyright Clearance Center and Nature Publishing Group. License #3331550507939.